Pest Control

WORLD CROPS

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A Micronette Sprayer applying oil-based fungicides to bananas

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WILLYS-OVERLAND EXPORT CORPORATION, TOLEDO, OHIO, U.S.A.

WAR ON PESTS

Britain's First Pest Control Exhibition

Preparations for the CROP PROTECTION AND PEST CONTROL EXHIBITION – briefly announced in our last issue – are going forward rapidly. This exhibition, sponsored by WORLD CROPS, will take place at the Royal Horticultural Society's New Hall, London, from 12 to 15 May, and is the first public specialised exhibition in its field, ever to be held in Britain.

Although the accent is mainly on agriculture and horticulture, the exhibition will also deal with industrial and domestic pest control, and a wide variety of products and services will be on view.

Many leading firms have accepted with alacrity this opportunity to display their manufactures not only to the home trade and consumer, but also, it is anticipated, to many overseas visitors. Overseas publicity for the exhibition is being conducted with the kind assistance of the British Travel and Holidays Association, B.O.A.C., B.E.A. and other organisations. It is expected that many visitors from outside Europe will take the opportunity to see this important exhibition before or after their journey to Brussels for the Universal and International Exhibition.

All overseas visitors to the Crop Protection and Pest Control Exhibition are being given tickets of honorary membership in the Exhibitors' Club, a facility which will enable foreign importers, buyers and users to meet both British and overseas exhibitors in a pleasant and informal atmosphere.

It is hoped that some manufacturers of insecticides and applicators will take the opportunity of presenting new products to the trade and the public at this exhibition, which will turn the spotlight of publicity on the important field of pest control. There are already indications that one or two of the larger manufacturers are proposing to show new products.

At the time of going to press a few stands are still available for those manufacturers and distributors who have not yet booked their space. Stands available include one or two of the ' shell ' stands, which enable exhibitors to display their goods with a minimum of trouble. It will be permitted to sell samples and equipment to the public, subject to the exhibition regulations.

Enquiries regarding stand bookings should be addressed to the Exhibition Sales Manager, Crop Protection and Pest Control Exhibition, Leonard Hill House, Eden Street, London N.W.1.

Editorial Comment

More or less

A SPECIALIST is one who learns more and more about less and less; we sometimes wonder whether an agricultural journalist is one who learns less and less about more and more.

Science is an ever-expanding activity, constantly branching out in new directions. It is as essential for the farmer who is directly concerned to obtain some idea of what is happening as it is for specialists working in related fields to keep in touch with what others are doing.

The need for communication between scientists and non-scientists, and between specialists in one field of research with those working in other fields of agriculture and agricultural research, is one which we hope WORLD CROPS is successful in meeting. We were, therefore, shocked to learn recently that, at one of the leading agricultural stations in the U.K., responsible officers were concentrating so hard on their own individual problems of agricultural research that they did not find time to read WORLD CROPS. How else, then, can they hope to keep abreast with what is happening in other branches of agricultural science or learn of the increasing contribution of the engineering and chemical industries to agriculture, and of the significant changes that are taking place in the pattern of world agriculture.

It is perhaps an easier matter to give an account of work done on some practical problem of applied research than it is to give a proper and complete understanding of the methods of fundamental research into problems of no less, and often far greater, importance to practical agriculture – such as the use of radioactive or tracer elements in the study of the uptake of plant nutrients, the mode of action of insecticides and the movement of systemic herbicides within the plant. The truth of the matter is that not all scientific ideas can be simply explained or easily understood and, furthermore, ' a little knowledge can be a dangerous thing '.

We were reminded, when we listened in recently to an address broadcast by Dr. R. Scott Russell, the newly appointed Director of the Radioactive Laboratories of the Agricultural Research Council at Oxford, that it was after a popular article on the subject had appeared in *Life* some three years ago that we ourselves were denounced for not having investigated the possibilities of using this new, and then unknown, technique for the investigation of the uptake of plant nutrients by the coconut palm – an impossible proposition at that stage, quite apart from the financial aspect.

In his talk, Dr. Russell referred particularly to his studies of the uptake of radioactive ' labelled ' phosphorus by plants under laboratory conditions. The basic idea is to use the principle of isotopic dilution to determine how much of the phosphorus in the soil is freely available to the plant and how much of it is fixed. Before this method was available we had to rely on chemical analysis, which did not distinguish between nutrients in different chemical forms in the same way as does the living plant. It is for this reason that the results of chemical analysis, even the most accurate, are misleading.

Now we have a means of measuring the effect of adding fertilisers to the soil, or we can compare the nutrient reservoirs of different soils, and ultimately we can use these methods to determine metabolic processes, even those of short duration, within the plant. That this is not just an exercise in academic science can be seen from a short note on the application of the tracer technique to the study of the mechanics of the action of herbicides within the plant, which appears elsewhere in this issue (see page 64).

Dr. Russell concluded: ' Radioactive tracer methods have opened up wide new approaches to the study of plant nutrition and thus to the better understanding of the fundamental sources of the food of man . . . so that in due course practical benefits should result to the farmer '.

Asia at the crossroads

WE HAVE repeatedly drawn attention to the deteriorating situation in the Far East (WORLD CROPS, 1957, **9**, 135, 223, 318 and 400). Under the smoke screen of trouble in the Middle East and an artificially contrived crisis between Turkey and Syria, Russia has been quietly and steadily strengthening her position in the Far East, where at any time now we may expect to hear of Russian aircraft flying over Djakarta, even as they are today flying over Cairo and Syria. One crisis more and we may expect to hear of Russian aircraft at Negombo and Russian submarines at Trincomalee. The exchange from a benevolent colonialism to a ruthless dictatorship would then be a *fait accompli*, and after that it could be the turn of India, with a bridgehead already established in the Communist state of Kerala.

This dangerous situation, which would have far-reaching economic consequences for what for convenience is called the ' West ', would bring misery, death and disaster on a colossal scale to the ' East '. Russia is neither ' East ' nor ' West ', but the relentless, pitiless and incalculable force of evil. Communist Russia is without any form of god, without any settled principles and without any established tradition – ' a land of frustrated ideals ' (H. G. Wells). It is for the East to realise what is happening and to resist this

peaceful penetration now before it is too late, for it is easier to get a police state than it is to get rid of it. *Remember the fate of Hungary.*

That great statesman, Mr. Nehru, has made this appeal: '. . . the great powers must pull together to prevent world disaster'. If this is how the Prime Minister of India regards the present situation we need make no excuse for referring to it again. If the situation continues to deteriorate, it will mean the end of ordered agriculture in Asia; it will mean, as occurred in Russia, the deaths of millions by violence and starvation; it could easily precipitate the nuclear war, and the Four Horsemen* of the Apocalypse would then ride again into the Second Dark Age in the history of the world.

* The four scourges of mankind: fire, famine, disease and death in war.

Plant viruses

A TEST that detects plant viruses in only 45 minutes instead of three to seven days as was previously required has been developed at Pennsylvania State University.

The new method for early detection may have great economic importance in view of millions of dollars of damage caused by virus diseases of tomatoes, potatoes, sugar-beets and other crops.

In the procedure a 2% suspension of red blood cells is added to juice extracts from either the leaf or fruit tissue of a plant. Clumping of the red blood cells indicates virus infection, and the test has such great sensitivity that it has shown up virus invasion as much as one month before a seemingly healthy tomato plant showed any overt signs of definite infection.

Instinct and reason

IN THE past the gardener was exhorted to 'keep the hoe moving amongst the crops' and the farmer considered that his crops suffered by just the amount that cultivation fell short of this ideal. The belief was instinctive. Indeed, the notion was so general that it was incorporated into stories which assumed the nature of fables. Thus a farmer on his death bed told his sons that he had buried his treasure deep in one of the fields, but before he could indicate which one he passed on. The sons dug and redug every inch of the farm, but, to their anger and disappointment, found nothing. Yet, in due course, bumper crops were harvested and these pointed the moral that hard work produces treasure and brings its own reward.

A modern version of the same story was current during the last war. A soldier wrote home and told his wife that he had buried in the garden the details of his regiment's movements. The censor opened the letter, of course, and a squad of men was sent to dig over the garden to a great depth. Nothing was found and the exasperated wife wrote to her husband asking what she should do about it. The answer came: 'Put in the potatoes'.

During the early decades of the century Assam tea planters firmly believed in what they termed 'tincture of steel'. Estates were deep-hoed to 9 in. each year and light-hoed to 5 in. each month, if labour were available. Every third year each section was trenched between the rows of tea to a depth of 18 in. and the amount of broken roots turned up was a measure of the thoroughness of the operation.

Scientists have been making field experiments in agriculture for well over a century, although little was done in the way of cultivation tests. The earlier workers explained the movement of soil moisture by the phenomenon of capillarity which fitted in with the use of mulches and the traditional belief that hoeing conserved soil moisture. However, as early as 1897 the study of the dynamics of soil water in America gave the first hint that all was not well with current views. Later study in Holland, in 1917, and subsequently at Rothamsted, worked out the correct theory of the moisture movement in soil and confirmed it experimentally.

Meanwhile, in 1919, at the Tea Experimental Station, Tocklai, Assam, simple cultivation experiments were laid out, ranging in soil disturbance of the most vigorous and deep kind, including trenching, deep hoeing and a monthly light hoe, to the omission of all hoeing whatsoever. In the last case weeds were carefully removed by hand with the minimum of soil disturbance. To the surprise of the scientists, it became apparent within a year or two that the less the soil was disturbed the bigger the crop, provided weeds did not take charge. By 1925 it was concluded that cultivation *per se* in tea fields was of little value, and in excess was harmful, and that weed growth, especially grasses, constituted the real danger. Within two or three years the tea industry in North-East India cut down cultivation to a minimum, consisting of a shallow scrape, with an especially designed so-called *cheel* hoe, in the spring. Pruning and plucking were adapted to give the bush a wide spread so that the cover thus produced helped to keep the weeds in check. The saving in labour costs made by these changes amounts to about £2 million per annum.

In 1930, cultivation experiments began at Rothamsted, and it was definitely shown that annual crop yields were remarkably insensitive to variations in soil disturbance. All the experiments were full-scale trials. Subsoiling in the heavy Rothamsted clays had no effect on sugar-beet production. The omission of the normal autumn ploughing for the spring seed-bed of potatoes or sugar-beet had little harmful effect, and certainly not enough to pay for the extra work. Annual deep ploughing was no more efficient than shallow ploughing. Inter-row cultivation either reduced the yield or gave no increase. One hoeing in the early stages of

growth, when the young plants are particularly sensitive to weed competition, is worth many afterwards.

The net result of all this work showed that, provided a crop has a reasonably good seed-bed and early hoeing to keep the weeds in check, any cultivation, whether before sowing or during growth, in excess of the minimum is of little value.

These results agree with those obtained in America and are in line with modern knowledge of soil physics, but they conflict with a deeply ingrained tradition. Why, then, it might be asked, has the farmer who has been working the soil in Britain for 2,000 years been in the wrong all the time? The prime reason is that before the farmer had efficient machinery he was always fighting a losing battle against weeds, and cultivation at every available opportunity was his only hope. Again, cultivation in the early stages of growth sometimes produced striking results and it was assumed that the yield would benefit accordingly.

In the Ceylon tea plantations a clean soil and annual deep forking is the general rule. In a recent issue of the *Tea Research Institute Journal* a complete *volte face* is made on the subject. The right-angled metal strip used for scraping the soil clean of weeds (and, incidentally, loosening it to soil erosion) is described as 'the most insidious thing to be found in Ceylon', whilst the use of the long-tined fork is discredited. The suggestion is that cultivation shall be reduced and that the bushes be pruned and plucked in a manner to induce a wide spread to cover the soil and help to control weed growth. Thus field methods in Ceylon tea estates will move into line with those followed for many years in South India and in Assam.

Use of fertilisers

RESISTANCE TO the use of the so-called artificial fertilisers by the farmers of the world is markedly declining. A study of the FAO 'Yearbook of Food and Agricultural Statistics' reveals that world consumption of the three major commercial fertilisers has increased twofold since before the war. Excluding the Soviet Union, world consumption of nitrogenous fertilisers increased from 2.5 million metric tons in 1938 to 6.3 million in 1955–56. Consumption of phosphoric acid in 1938 was 3.6 million metric tons; in 1955–56 it was 7.3 million metric tons. Consumption of potash fertilisers rose from 2.6 million metric tons in 1938 to 6.1 million in 1955–56 (see page 59).

But it is not only the countries with highly developed agriculture which show large increases; so also do a number of other countries. India, for instance shows a ninefold increase from 16,000 metric tons to 144,000 metric tons; while in Hungary consumption rose from 3,000 to 50,000 metric tons, and in Peru the figure rose from 19,400 to 53,500. The U.K. used 60,000 metric tons in 1938 and 296,000 in 1955–56; France 218,000 and 353,000 and the U.S.A. 329,000 in 1938 and over 2 millions in 1955–56.

*Millions still go hungry**

THIS IS the title of a book recently published by FAO, which is a valuable background to the great work it is trying to do. It will be of immense interest to those who feel concern at the problem of malnutrition amongst so many of the under-developed nations and at the situation that exists where so much needs to be done to make greater use of the land available – and also, paradoxically, to solve problems of too abundant supplies of some commodities, such as wheat.

It is always easier for the man who is remote from the scene of action to criticise than it is for him to understand the difficulties that give rise to the conditions he is criticising, but destructive criticism with no real appreciation of the difficulties involved is a negative and useless exercise. (Angry Young Men please note.) We hope that this book will bring to the notice of a wide and varied audience the magnitude of the problems which have confronted FAO since its establishment some 12 years ago, because in our view an understanding of these problems will inevitably be an aid to their solution.

Contact between the nations of the free world has increased to an enormous extent since the second world war and we are, in consequence, far more conscious of differences in our ways of living, nation with nation, than we have ever been before. Speaking only for the free world, this was bound to have had some unhappy consequences, as well as happy ones, because the less well-off, becoming suddenly conscious of their state, look round for someone to blame and, because of their limited experience – and influenced by trouble-makers with an axe to grind – they do not always come to the right conclusion, or they see a situation as the outcome of a single cause, when, in fact, there are many contributory factors.

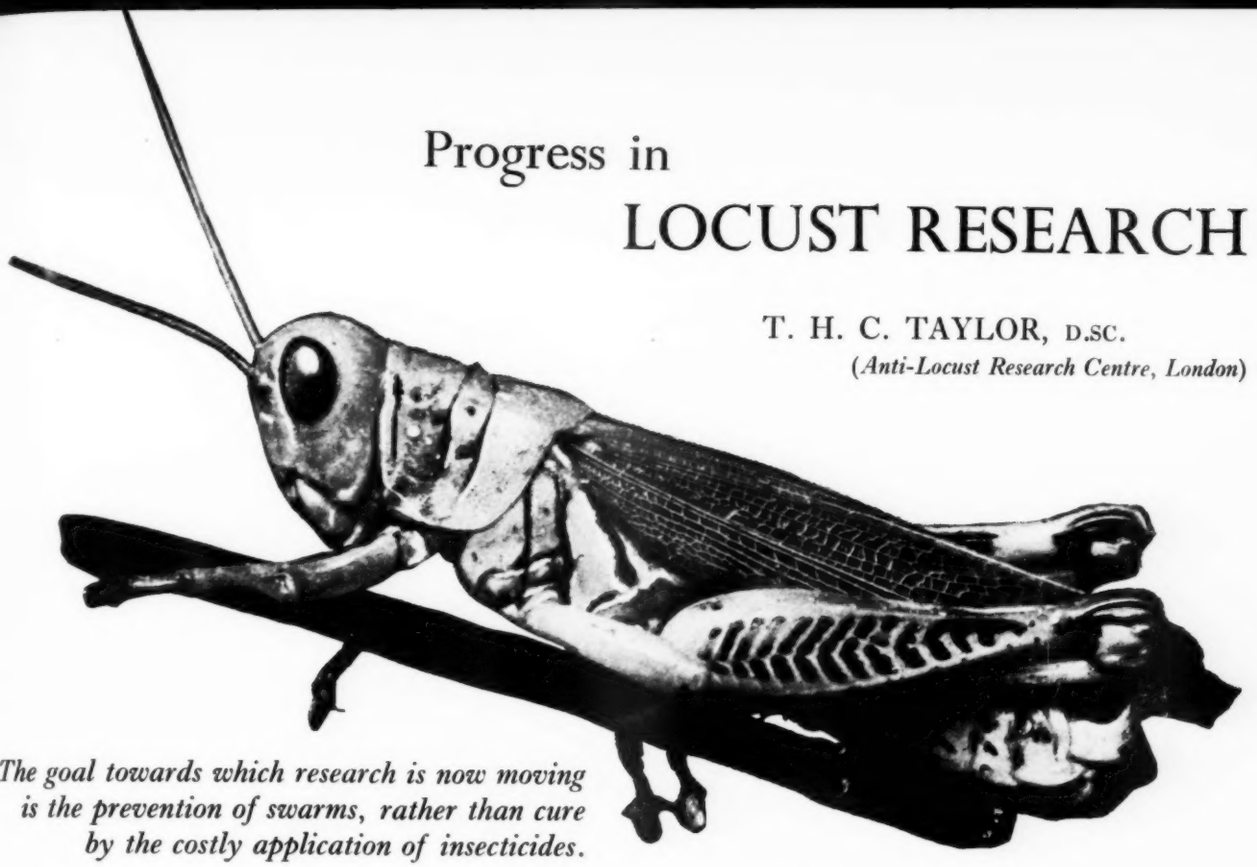
FAO is concerned to make available to the under-developed countries, knowledge gained sometimes over hundreds of years elsewhere, but it is frustrated in its operations time and time again, because of the inevitable lack in these countries of trained personnel. Moreover, education itself is a very wide subject. A man is not a receptacle for maximum knowledge whether for growing more food or for any other purpose; if he does not at the same time absorb wisdom in human behaviour, he will not be able to put the knowledge acquired to its fullest use and his lack of vision will create further obstacles to human progress.

Another obstacle to progress is that too often an agricultural department is regarded as the poor relation amongst the government departments, with the result that a low priority tends to be given to agricultural matters, even where agriculture is the mainstay of the economic structure of the country. It is vital that immediate needs should not be allowed to take precedence over the future development of the nation.

* Published by FAO in Rome, price $1.00 or 5*s*.

Progress in LOCUST RESEARCH

T. H. C. TAYLOR, D.SC.
(*Anti-Locust Research Centre, London*)



The goal towards which research is now moving is the prevention of swarms, rather than cure by the costly application of insecticides.

MODERN methods of prevention of damage to crops by locusts involve the application of insecticides in the right places at the right times. The control of many other insect pests also involves this; but there the similarity ends, for in the case of locusts the insecticides must usually be applied, not on the crops that are to be protected, but where the locusts breed, often in places hundreds of miles away from appreciable areas of cultivation. Many of these breeding places are difficult of access, and in terrain in which pest-control operations require special and elaborate organisation and equipment, such as deserts or seasonal swamps.

The methods of application of the insecticides are frequently being revised to conform with the results of laboratory and field research, and new insecticidal chemicals or formulations are adopted as soon as they have been shown to be more economical and not to be harmful to man or domestic animals in the concentrations and dosages employed.

In spite of improvements in these respects, however, the control of locusts by insecticides (which must be applied in as many as possible of the areas in which multiplication of the insect becomes dangerous) involves heavy annual expenditure, and since there is no possibility of exterminating locusts, the expenditure must continue indefinitely. Moreover, concerted action by many different countries, which is needed for the control of the Desert Locust in particular, is, for political reasons, very difficult to achieve.

The purpose of this article is not to describe the progress made in the use of toxic chemicals against locusts, great though it is, but rather to indicate the lines of research that are directed towards a more radical solution of the locust problem. The fundamental reasons for the harmfulness of locusts are their swarming and migratory habits, and these are not yet adequately understood.

Anti-locust research

The Anti-Locust Research Centre in London exists mainly to help to solve these difficult and complicated questions. It conducts, sponsors and encourages research on locust ecology, behaviour, geography, physiology and taxonomy, as well as control by insecticides. It receives regular reports of the movements and occurrences of locusts in the countries of Asia and Africa and from them prepares monthly summaries of the current situation and monthly forecasts of future developments for the benefit of all the countries concerned. It also serves as a centre of information on locusts and related insects, and publishes, or fosters the publication of, the results of scientific research concerning them. While its policy is directed towards the solution of the fundamental problems of the activities of locusts, it recognises that this is a long-term project and that the control of locusts by direct destruction is a practical necessity in the meantime.

There is, in any case, no sharp distinction between the long-term and the short-term aspects of locust research; for example, the search for ever more effective insecticidal chemicals, that kill when applied externally, requires some understanding of the basic structure and physiology of the cuticle and the nervous system. Similarly, the development of the use of stomach poisons involves investigation of the feeding habits of the locusts in the different stages of growth.

Much research is being done in countries, such as Australia, India and numerous territories in Africa and the Middle East, by organisations or individuals having no direct connection with the Anti-Locust Research Centre, but as soon as such work is published it becomes known to the Centre and, through the Centre's library and documentation services, to all scientists

Locust hoppers on the march

Photo: Shell

Tanganyika official photo

An approaching swarm of locusts

pursuing similar lines of work elsewhere.

The swarming habit

Locusts occur in all five continents and there are several different species. Each has its own area of the earth's surface and the areas of distribution of the different species, though overlapping in some cases, are distinct and definable. All the species have in common a capacity for gregarious behaviour and for travelling great distances as coherent swarms, but they also exist as populations of scattered individuals showing no gregarious behaviour whatever and differing in no way from grasshoppers.

A locust is, in fact, merely a grasshopper that can swarm, and the difference is only of degree, there being grasshoppers that show tendencies to some gregarious activity, while there are also differences in degree of gregariousness among locust species. Each species of locust is liable to develop gregarious habits in only a relatively small part of the region over which it is distributed, occurring elsewhere in its region as an ordinary solitary grasshopper.

Some locust species, such as the Red Locust and the African Migratory Locust, are largely restricted, so far as the commencement of gregarious multiplication and swarm formation are concerned, to particular places, rather clearly delimited by natural features, within their distribution regions. These places are known as outbreak areas because any swarms that escape from them are liable to initiate locust plagues that may spread over a large proportion of the continent and continue for years.

In the case of the Red Locust, after many years of ecological and geographical investigation the principal outbreak areas are now known to be the Rukwa Valley of southern Tanganyika and certain neighbouring depressions, and a corresponding area for the African Migratory Locust is the flood plains of the River Niger in the French Sudan. Both of these locusts are also present in many other areas of Africa, south of the Sahara, but normally only as non-gregarious grasshoppers. The breeding of solitary individuals of either of these species in places other than the outbreak areas does not normally give rise to swarming populations, but if swarms that are allowed to escape from the outbreak areas breed elsewhere their progeny travel widely and may give rise to very severe further swarm formation.

Certain other locusts, notably the dreaded Desert Locust, which, as a species, is distributed from India to West Africa and down to southern Africa, have no definite outbreak areas, but even for the Desert Locust there are certain areas – unfortunately, vast and widely separated, though forming only a small proportion of the whole distribution area – within which swarms and swarm-breeding occur far more frequently than elsewhere, as has been shown by careful analysis of thousands of records accumulated over many years. Here again, therefore, there are particular areas that demand special ecological investigation if swarming is to be limited or prevented and the species is to be reduced to a relatively innocuous status.

Swarming behaviour

No matter how the problem is approached, the aspect that appears the most fundamental and crucial is always the same. The question is what constitutes the difference between the non-swarming and the swarming forms? Most of the research that is being conducted, other than that which is concerned with the immediate suppression of locusts by insecticides, bears directly or indirectly on this question.

It is known that the proximity of the locusts to one another and the duration of periods of close proximity influence the degree of gregariousness developed and that different locust species and different races of the same species are not equally sensitive in this respect to crowding. It has also been shown that locusts reared in isolation and then crowded together soon learn to behave gregariously and, if then isolated again, are slow to unlearn this lesson. Moreover, gregariousness in the parent locusts is passed on to their progeny in the form of greater readiness to live and move in concert and of certain colour and dimensional changes which are outward and visible signs of internal changes.

Much experimental laboratory work on these lines is being done and will be continued, and at the same time attention is being paid in the field to non-swarming populations, harmless in themselves, and the environmental

factors that might transform them, immediately or after breeding, into swarms. There are indications that swarming behaviour sometimes occurs in the field in previously non-swarming, sparsely distributed adult locusts; on the other hand, moderately dense populations sometimes show little tendency towards gregarious behaviour, existing and breeding for more than one generation in the same place without any apparent change, and then, relatively suddenly, they develop gregariousness and depart as flying swarms.

Causative factors

There is no doubt that the density of locust populations is a factor in the development of concerted behaviour, but multiplication by breeding alone cannot explain it. The popular conception of locusts as insects capable of multiplying extremely rapidly is erroneous. It arises from the fact that they are seen in millions in vast swarms sometimes covering scores of square miles, but the number of eggs laid by locusts is small in comparison with the number laid by many other kinds of insects. Moreover, the rate of development is relatively slow, and in any one place breeding is limited by extreme seasonal climatic or other environmental changes. The initial acquisition of swarming tendencies must, therefore, often involve the action of concentrating factors on the adults or the early stages.

Several such factors are known or suspected and the whole problem of how scattered adult locusts are brought together has received much attention in the past and is prominent in most research programmes. Since flight is presumably involved, investigations of the environmental conditions in which individual locusts take wing in the absence of disturbance have been undertaken, by night as well as by day, it being known that non-swarming adults of some species fly at night.

Probably the most important factor that brings large numbers of scattered flying locusts into the same general area is convergent winds; the further concentration that takes place within that area is brought about by very local topographical or ecological circumstances, which include, for some locust species, patchiness of vegetation, change in the components of continuous vegetation, and depressions and runnels holding more moisture than the surroundings, and, for certain other locust species, bare patches of loose or cracked dry soil.

The moisture content and the texture of the soil are vital factors in the lives of locusts, since the eggs are laid in the soil and need water either immediately or later, according to species. Grouping of female locusts for egg-laying is usual, and it is at least partly due to choice of appropriate soil conditions in a very patchy environment. The means of recognition by the locusts of soils suitable for egg-laying and the precise stimuli and sensory mechanisms that result in either the act of egg-laying or, in unsuitable soils, the withdrawal of the ovipositor without any eggs being laid are important subjects which are yet to be studied in detail.

Locusts massed together in a breeding cage. The electric light bulb provides warmth and light, replacing the sun. Food is fresh grass and bran; sticks, for climbing and to fly from, provide recreation

Photo: Central Office of Information

Progress of swarms

Since prolonged flight and mass migration are the most characteristic activities of populations of gregarious locusts, a great deal of research has been done and is in progress on the flight of individuals and of swarms. The mechanics and physiology of the flight of the individual have been very intensively studied.

Locust swarms, comprising many millions of individuals, usually move in a 'rolling' manner, a proportion of the locusts always being on the ground; those on the ground resume flight when the rear edge of the swarm passes over them, if not sooner, and so are not left behind. The period spent on the ground serves for the replenishment of the supply of fat which constitutes the principal fuel for flight, and investigation of the rate of consumption of fat by locusts artificially induced to fly in an air stream has provided data for estimating the maximum period during which a locust can remain air-borne in continuous flight; periods of gliding, which is commonly observed in air-borne swarms, may considerably increase the duration of the period spent on the wing.

The fact that migration by flight is not confined to swarms, but also occurs in non-gregarious individuals, and in some species at night, suggests that knowledge of the physical environment (especially the limiting temperatures) associated with flight may lead to fuller understanding of the concentration of non-swarming locusts. This applies particularly to the Desert Locust, which depends largely upon the

An impressive picture of damage done by locusts
(Left) *Orange trees in full leaf . . . and* (right) *trees in the same area after locust devastation*

Photos : Anti-Locust Research Centre

erratic rainfall of desert and semi-desert regions for localised soil conditions that enable it to breed.

There is much evidence that the so-called migration of swarms of the Desert Locust is a process of passive transportation by moving air masses and is not due to directed flight by the component individuals. The structure of locust swarms is being intensively investigated by specially designed photographic and cinematographic techniques, and it appears that there is no uniform orientation within a swarm, but rather that a swarm consists of numerous groups orientated more or less at random, though within each group all the locusts are heading in approximately the same direction. Sometimes the groups are so large that an observer looking vertically upwards gets the erroneous impression that there is uniform orientation throughout the whole swarm and that the orientation of the locusts that he sees indicates the direction of migration of the swarm.

The discovery of the dependence of all major locust migrations on winds has clarified much that was previously obscure; in particular, it has explained the more or less seasonal migrations of swarms over hundreds of miles and the synchronisation of the arrival of locusts with the rain that they need for maturation and breeding and which is brought by the same wind. Great impetus has been given by these discoveries to the study of weather in relation to locust phenomena and it may reasonably be hoped that this will lead to forecasting the movements and breeding of locust populations more reliably and longer in advance than is at present possible.

Swarm cohesion

The structure of locust swarms and the turbulence of the air in which they often find themselves would lead to their disintegration, if there were not some cohesive factors at work. In fact, swarms persist as entities for many weeks, while migrating and while stationary, often without appreciable reduction in size. Similar cohesion is characteristic of marching bands of locust ' hoppers'.

This cohesion brings us back to the basic question of the difference between the solitary and gregarious forms. Cohesion implies a reaction of the locusts to one another which prevents dispersal at the edges of swarms and bands, and observations have confirmed that, while individuals are constantly moving outwards at the edges, they invariably turn back towards their fellows after being separated from them by a distance of a few feet only. Much current research is devoted to this fascinating and complex aspect of the locust problem. It seems probable that vision is the principal factor in the reaction, but smell and the perception of sound are also being intensively studied.

Associated with the uniformity of behaviour of both adults and hoppers in swarming populations is a high degree of uniformity in rate of development, so that all the individuals are in almost the same stage of growth or sexual maturity at the same time. Laboratory investigations have already pointed to some of the mechanisms by which this is achieved; for example, it is now known that the presence of mature locusts among those sexually immature causes them to mature rapidly, and it is probable, therefore, that in the field any tendency towards individual irregularity in this respect is smoothed out, so that all the locusts are ready to lay eggs at the same time and uniformity of behaviour is maintained.

This article must end as it began, with insecticides. The ultimate goal of research on locusts is the prevention of swarming, but, despite great progress, it is not yet possible to judge to what extent a full understanding of swarming will provide means of combating the locust menace without annual recourse to toxic chemicals. In the meantime, the policy of the various national and international organisations responsible for controlling locusts must be steadily to increase efficiency by combining more economical utilisation of insecticides with reduction, by the application of ecological knowledge, of the areas that need to be treated. Complete co-ordination of action among all the countries concerned is essential if this policy is to be effective.

Blood Tests for Users of O.P. Insecticides

E. F. EDSON

(Head, Medical Department, Fisons Pest Control Ltd., Chesterford Park Research Station)

It is now possible for field supervisors to detect dangerous degrees of over-exposure to organo-phosphorus insecticides and to take immediate steps to correct unsafe methods of operation.

MOST scientists concerned with the use of organo-phosphorus (O.P.) insecticides know that their main toxic effects in man, animals and probably insects are due to inactivation of 'cholinesterase enzyme'. They are usually not quite certain what cholinesterase enzyme is, or does, or how it can be measured, or of the significance of blood cholinesterase depression. Organo-phosphorus insecticides continue to increase in use in most countries, so it is important that those who advise or control their use should understand the principles underlying the 'blood ChE test', what the results mean in terms of safety to workmen, and that the test can now be carried out even in remote areas, away from a laboratory.

How cholinesterase works

In vertebrate animals, some bodily actions are voluntary, *e.g.* the movements of limbs, trunk, facial and tongue muscles. Others are automatic, or involuntary, *e.g.* heart muscle contraction, gut movements, pupil size, glandular secretions. The regulator of all these activities is the brain. Its stimuli are transmitted by nerve fibres to the effector cells. At the nerve ending the energy of each nerve impulse is used up in causing the production of minute amounts of a 'chemical mediator', which promptly stimulates the effector cell into activity. Adrenaline is one such mediator; acetyl choline is another. Under the stimulus of acetyl choline muscle fibres contract, gland cells secrete and nerve cells release a further impulse. Unless this acetyl choline were quickly removed, these cells would continue to respond uncontrollably and in a disorganised sort of way. That is where 'cholinesterase' comes in. Cholinesterase is an enzyme, a form of biological catalyst, which converts the acetyl choline into harmless, minute amounts of acetic acid and choline. Enzymes can carry out this type of reaction thousands of times per second without themselves being destroyed. Thus, cholinesterase is a vital enzyme because it controls the chemical, acetyl choline, which mediates vital brain stimuli. All our bodily tissues, and probably all animal species, rely on cholinesterase enzyme to keep muscles, glands and nerve cells working in a harmonious and organised fashion. There is more than one type of cholinesterase in most species and in most tissues, but as yet scientists are not certain what particular jobs the other variants of cholinesterase perform. There is little doubt that the '*true*' or *acetylcholine*-esterase is the most important member of this family of enzymes.

Symptoms of poisoning

If tissue cholinesterase activity is rapidly reduced to low levels, the acetyl choline produced at nerve endings cannot be destroyed fast enough, and accumulates. The effector cells then undergo non-stop stimulation, to which they respond for as long as they can hold out, by contraction of muscles, secretion by cells, or massive discharges of nerve cell impulses. Thus, the toxic effects of accumulating acetyl choline, or a chemical which inactivates cholinesterase of tissues, would include fine and coarse twitchings of muscle fibres in the limbs, trunk, face and tongue; disordered muscular activity of the stomach, gut, pupil, bladder, bronchi, heart; excessive secretion of tears, saliva and mucus within the gut and lungs; inco-ordination, confusion, then convulsions. In severe cases the effector cells become exhausted and cannot respond any longer. The breathing then becomes weak, laboured and intermittent, the heart beats more slowly and feebly, the body cools down and eventually death occurs.

If tissue cholinesterase activity is

only slowly reduced during a period of many hours or several days, animals and man can in some way adapt themselves, so that normal functions continue despite very low levels of activity. If the same depression of cholinesterase had been caused within minutes or an hour or two, death or severe poisoning would probably have resulted. This may be due to two factors: firstly, the tissues are constantly making more cholinesterase to replace that lost in 'fair wear and tear'. Secondly, some slight spontaneous reversal of enzyme inactivation is likely to occur, even with the most aggressively anti-cholinesterase chemicals. If a near-fatally poisoned animal can be kept 'alive', *i.e.* oxygenated, by artificial respiration, the vital brain centres and effector cells may adapt themselves within a few minutes and, in some as yet unknown way, can survive on the traces of cholinesterase enzyme, recovering from inhibition by the O.P. chemical, or being newly made at the cell.

Although severe liver disease, severe malnutrition and certain therapeutic drugs may affect cholinesterase levels, the only serious threat to cholinesterase activity comes from over-exposure to the existing organo-phosphorus insecticides, which are all potent inhibitors of cholinesterase. The amount required to cause fatal inactivation of

the enzyme varies tremendously from compound to compound, but even malathion, the least toxic to mammals, causes its acute toxic effects in the same way as the most toxic, TEPP, by inactivating cholinesterase.

Some O.P. insecticides inactivate cholinesterase on first contact with it, *e.g.* as they are absorbed through cells of the gut, lungs, skin or eye. Although skin absorption causes no local toxic effects, trace quantities of such 'direct' inhibitors may cause marked local effects on eyes, gut or lungs (small fixed pupils, blurred vision, headache, tightness in the chest, nausea, colic, even vomiting), with only slight or no effects on blood cholinesterase activity. The ' direct ' inhibitors include paraoxon, TEPP, HETP, demeton, methyl-demeton, thimet, diazinon, amiton and several others. Contamination with traces of these materials will cause inactivation of cholinesterase in a blood sample, *e.g.* from chemical left on the skin or contamination of the sample tube etc.

Some other O.P. compounds (*e.g.* pure parathion, schradan, dimefox) are almost inactive against cholinesterase until they have been ' activated ' in the animal's liver or in the insect's tissues and may cause profound cholinesterase depression and systemic toxic effects without any local effects on the lungs or gut from which they were absorbed. Such compounds, the ' indirect ' inhibitors, do not cause inhibition of cholinesterase as incidental contaminants of blood droplets or samples. They can, in fact, be applied to the eye in lethal quantities without causing even pupillary constriction.

Sensitivity of blood cholinesterase

Experimentally, it can be shown that the first detectable response to the absorption of single or repeated small doses of O.P. insecticides is inhibition of the cholinesterase activity of the circulating blood.

Dietary trials with animals have shown that the daily absorption of even one-hundredth of the acute oral LD 50* dose causes detectable cholinesterase (ChE) depression within 1–3 weeks. With some compounds even one three-hundredth of the acute LD 50 causes such detectable response. Thus, depression of blood ChE activity is a very sensitive indication of exposure and absorption.

Trials with human volunteers have shown that the daily intake rate, causing not more than 20% decrease in red blood cell cholinesterase activity, is about 0.1 mg./kg./day for parathion, 0.02 mg./kg./day for schradan, and 0.005 mg./kg./day for dimefox. Such intake rates can be maintained by humans for at least weeks without further cholinesterase depression and by animals for months or even years without toxic effects of other detectable type.

Thus, if field operations with O.P. insecticides can be carried out so that no significant depression of blood cholinesterase occurs, there is no probability of hazard as far as present knowledge shows.

'Blood ChE tests'

The ' blood ChE test ' consists of allowing a small quantity of the blood to react upon an acetyl choline solution under standardised conditions and measuring the acidity developing as acetic acid is produced by the cholinesterase activity of the blood.

There are many methods of carrying out such a test in the well-equipped laboratory. In the ' Warburg ' manometric method, for example, the acetic acid is made to react with sodium carbonate to release gaseous CO_2, which can then be measured manometrically. Electrometric methods measure the increasing acidity in the solution, using a pH meter, under carefully controlled conditions. Titrimetric methods also exist. One of the most useful simplifications was made by Limperos and Ranta in 1953, however, who showed that the dyestuff bromothymol blue changed its colour from blue-green to yellow-brown within the range of acidity produced by a small drop of normal blood (0.01 ml.) reacting with a solution of acetyl choline for 25–30 minutes. This opened the way to the use of the blood ChE test away from the laboratory, as no very specialised laboratory equipment was required.

O.P. insecticides have been used in recent years for crop protection and public health campaigns even in countries where facilities for laboratory determination of blood ChE activity are non-existent, or inadequate due to the distances involved. For some years this laboratory has run an ' air-mail ' blood test service for special operations in such areas. In this, 1–2 ml. citrated whole blood samples have been air-mailed from, *e.g.* South Africa, Ghana or the Sudan, collected by car at the airport and the ChE activity determined by the electrometric method, the results being immediately cabled to the sender. By this method it was found possible, for example, to procure, despatch, analyse and report upon 20 blood samples from West Africa, the whole cycle being completed within 24 hours.

Nevertheless, the ability to perform the blood ChE test promptly on the spot, and on one drop of blood, has always been kept as a target for O.P. operations in overseas territories. The main problem encountered in the use of the Limperos and Ranta method, and variants suggested by other workers subsequently, was in the reliability of estimates of colour change in the test-tubes on different occasions. It was decided that if a series of permanent glass standards could be provided, field investigators would have far more precision in comparisons of serial determinations on the same worker or among a group of workers. Secondly, difficulty often exists in such areas in obtaining scientific apparatus or replacement materials for any special tests, so the equipment had to be a complete ' kit '. Both these requirements now appear to have been attained, mainly due to close collaboration with Tintometer Ltd., whose experience in producing permanent coloured glass standards and portable test equipment has proved invaluable.

Field kit for blood ChE testing

The specification for the ' kit ' was that it should be one box containing all the materials required for a technical person to take small blood samples from a group of workers and to estimate their ChE activities. Accuracy should be sufficient to let him decide if they could safely carry on an O.P. spraying campaign with existing standards of care, or if greater care was needed, if any worker was significantly over-exposed, or if a worker's illness was due to O.P. intoxication. It had to be simple and convenient in use, resistant to tropical climatic conditions, and transportable by jeep without damage. The reagents to be used should be adequate in amount

* LD 50 = dose of chemical causing death in 50% of animals in that group.

The field kit for blood cholinesterase tests:
1. *' Pyrex ' reaction tubes;*
2. *comparator;*
3. *blood pipette, tourniquet and needles;*
4. *' Pyrex ' glass dropping bottles;*
5. *acetyl choline perchlorate ampoules;*
6. *working tray, graduated cylinder, beaker, cotton wool and BTB indicator*

and prepacked so that solutions could be made without weighing.

A series of nine permanent glass standards was first prepared, covering the range 0–100% normal whole blood ChE activity, at intervals of 12.5% normal ChE. The standards were calibrated from whole blood samples of known ChE activity as determined by the two laboratory methods. The nine standards were made up into a rotating 'cholinesterase disk', suitable for use in the Lovibond comparator. All ancillary items needed for the test were then assembled into a prototype kit. This was tested during a prolonged O.P. campaign in the Sudan and the field users' criticisms incorporated into a second prototype, which was tested in West Africa. The final version, illustrated, appears to have come very close to the specification, consisting of one box weighing about 12 lb. (6 kg.) containing all the required materials except distilled water.

The principle of the test is that the investigator measures the colour change produced by the 'unknown' blood samples and a normal control sample, using acetyl choline as substrate and bromothymol blue (BTB) as indicator.

The blood test

The test procedure is as follows:

BTB indicator solution (0.5 ml.) is added to each of the reaction tubes, one tube per subject. After thoroughly cleaning the skin of thumb, finger or ear of each subject, 0.01 ml. of his blood is obtained and added to the BTB in a numbered reaction tube. The investigator now prepares a similar control preparation from a person unexposed to O.P. insecticides or known to have normal blood ChE activity, or from a whole blood standard obtained beforehand. A blood 'blank' or control is made to back the comparator glass standards. Substrate solution (0.5 ml.) is now added to each reaction tube at regular intervals of 15–60 seconds down the row of tubes, commencing with the control tube. The control sample is placed in the glass cell of the comparator, its gradual colour change, from blue-green through to yellow-brown, being periodically determined. The control sample will have attained '100%' normal ChE colour within 20–30 minutes, depending on ambient temperature. The unknown samples are then successively transferred to the comparator cell and their ChE activity read off by comparison with the coloured glass standards.

The accuracy of the equipment and test has proved very satisfactory for the purposes intended, readings being within one disk (12.5%) of the true activity as determined by Warburg or Michel methods. The possibility of false low ChE readings is not great; they could arise from technical errors, alkaline contamination or trace contamination of the blood or equipment by strong direct inhibitors. Incorrect normal or high values may come from acidic contamination of the glassware. With careful technique these possibilities need not arise, and each of them applies to all existing methods for estimating cholinesterase.

The field kit includes polythene bottles for distilled water, stock substrate solution, and surgical spirit for thumb cleaning. Small 'Pyrex' glass bottles with calibrated droppers are supplied for substrate, indicator and distilled water. Blood pipettes (0.01 ml.), needles, plastic tube thumb tourniquet and cotton wool are provided for taking blood samples. 'Pyrex' reaction tubes permit testing of 20 samples per 'run'. Acetyl choline perchlorate is packed in 12 sealed ampoules (0.5 gm.), ready for solution in 100 ml. distilled water, and the BTB indicator is packed in tubes (0.25 gm.) ready for solution in 550 ml. water. A beaker is included for boiling BTB solution free from CO_2 where necessary, and thus restoring its blue-green colour. The comparator, cholinesterase 'disk' with three comparator cells, spare rubber teats, adhesive labels for identifying tubes, a 100-ml. unbreakable measuring cylinder and an instructional leaflet complete the kit.

With the help of such an assembly it thus becomes possible for supervisors to ensure that unsafe methods of working with organo-phosphorus insecticides are detected long before dangerous degrees of over-exposure arise, even in isolated locations, and thus to utilise the almost unique property of this group of chemicals, the production of a measurable response by the absorption of very small and almost harmless fractions of the dose required to cause serious or fatal intoxication.

ACKNOWLEDGEMENTS

The development of this field kit described above would not have been possible without the great help and patience of Mr G. J. Chamberlin and Mr. D. Heath, of Tintometer Ltd.

Floods in Ceylon

The recent floods are reported to have caused 260 deaths and made more than 300,000 people homeless. The most extensive damage is around five of the largest irrigation reservoirs or 'tanks' in the central and north Central Provinces. In recent years, large tracks of land, surrounding them, have been reclaimed from jungle and colonised. Continuous heavy rainfall filled these tanks to overflowing and led to the breaching of their bunds. The waters, so released, overwhelmed whole villages and inundated the rice-fields, destroying homes and crops. It has been estimated that the damage done to Ceylon's paddy lands amounts to £25 million and that it will take ten years to restore the Island's economy.

CROP PESTS MAKE HISTORY

The Congress held in Hamburg this year was attended by more than 2,000 people from 75 countries. The programme was a very crowded one, consisting of some 386 papers, speeches and addresses; there was even a colourful ballet on the deadly Colorado beetle and its suppression by modern methods of plant protection.

It is impossible to do justice to all the papers presented to the Congress and only a selection of abstracts can be given. The summaries included below concern insect pests; in subsequent issues papers presented in other sections will be considered.

PROF. HANS RICHTER, Director of the Federal German Institute of Agriculture and Forestry was the President of the Congress and the opening address was given by Dr. H. Lübke, Federal Minister of Food. The Otto Appel Medal was awarded to Prof. E. C. Stakman, of Minnesota, U.S.A., in recognition of his outstanding work in the field of plant pathology. (He is the leading authority on cereal rust.)

Pests in history

At the press conference preceding the opening it was stated that, according to FAO, the total annual loss in the world's grain crops, due to the ravages of animal and insect pests, amounted to 33 million tons – sufficient to feed 150 million people for a year. In the U.S.A. the total annual loss in agricultural production, due to plant pests and diseases, is estimated to be about 3 billion dollars and in Germany about 2 billion marks, representing the value of one-fifth of the annual harvest.

One pest alone, the Mexican boll weevil, in 1921 destroyed one-third of the cotton crop in America, causing a loss of a billion dollars, and in the middle of the last century a vine blight in Europe caused damage to the value of more than the cost of the 1870–71 Franco-German war. In the year 1845 the potato crop in Ireland was totally destroyed by blight; one-third of the population died in the subsequent famine and 1½ million people were forced to emigrate. It was the same blight which, in 1916, destroyed a third of the potato crop in Germany. The deadly Colorado beetle virtually won both world wars, as it infested all the arable lands because there was no one to control it. Today it could be easily controlled.

Pests respected neither boundaries nor frontiers and international co-operation for their control and suppression was essential. It was not only necessary to inspect plant materials entering a country, but crops, such as potatoes, which are exported should also be certified.

Spraying was today as important as manuring and it was stated that in Germany farmers were now spending 300 million marks a year on crop protection. Equally important, however, was the question of mammalian toxicity and the questions of toxic residues on food crops, correct application rates of poisonous chemicals and their effects on beneficial organisms, which all received careful consideration during the Congress.

New insecticides

Five new insecticides, introduced at the Congress, were claimed to have overcome certain limitations of existing products. Three are phosphorus compounds, which are rapidly broken down within the plant to form harmless residues; the others are chlorinated compounds, which are active against a wide range of pests, but are not unduly dangerous to man and animals.

Prof. E. C. Stakman, winner of the Otto Appel medal

'Phosphamidon', developed by Ciba in Switzerland, has a half-life of only two days; 'Phosdrin' is a vinyl phosphate developed by Shell, which is exceptionally short-lived and is effective even in very small quantities; 'Thiodan' is a chlorinated organic sulphur compound developed by Farmwerke Hoechst, and toxic to over 100 insect pests; and 'Hoe 2705', another of their products, a polychlorinated hydrocarbon, is notable for its very low toxicity to warm-blooded creatures, and thus it should prove valuable for safeguarding stored products.

A powerful new acaricide, amiton, which is being developed under the trade name of 'Tetram', will protect fruit trees and cotton, and there is no health hazard to consumers of the fruit, providing there is an interval of two months after the last treatment before harvesting.

INSECTICIDES

Phosdrin – a Short-lived New Systemic Insecticide, *by R. R. Whetstone, The Hague (Netherlands)*

In recent years increasing attention has been given in the U.S.A. to toxic residues remaining on food and forage crops at the time of shipment to consumers. Most of the present insecticides are relatively long-lasting and increasing limitations are being placed on their use close to harvest. As the losses to the farmer from insect attack on mature crops are high, there is a

definite need for a fast-acting, highly effective insecticide which could safely be used a few days before harvest. 'Phosdrin' appears to fill this need. On the basis of extensive field testing, this insecticide controls a wide variety of insects at dosages of 1 to 8 oz. per acre. It is an outstanding systemic, but is rapidly broken down within plants, so that most crops can safely be eaten 24 hours after treatment.

'Phosdrin' insecticide is defined as a mixture of 60% of the alpha isomer of 2-carbomethoxy-1-methylvinyl dimethyl phosphate and 40% of related materials. In field tests and semi-commercial use, the insecticide has given economic control of 35 insect species on 25 different crops. It is particularly effective on sucking insects.

The Rational Development of Selective Insecticides, *by R. D. O'Brien, Cambridge (U.K.)*

Synthetic insecticides have usually been obtained either by chance or by extensive syntheses, followed by screening and further synthesis of homologues of promising compounds. The alternative involves knowledge of the detailed mode of action of compounds of a desired class and of differences in their absorption and metabolism in various animals. With such knowledge selectively toxic compounds could be designed. Studies upon the distribution of certain activating and detoxifying enzymes in the mouse and cockroach have led to the possibility of introducing a group into an insecticide which will confer the property of a high ratio of the toxicities insect-mammal. This principle has been confirmed by the preparation of five new selective insecticides.

Soil Insecticides and their Uses, *by J. H. Lilly, Ames, Iowa (U.S.A.)*

The chlorinated insecticides have revolutionised the control of many important soil pests attacking our agricultural crops. This is due to their long residual action, their remarkable effectiveness at low dosages, and the fact that they are safe and easy to use. Effective soil insecticides include aldrin, heptachlor, chlordane, dieldrin, gamma BHC, lindane, DDT and endrin. In general, there is a wide margin of safety between the dosages that will do an effective job and those that would be toxic to crops and beneficial to soil fauna and flora.

Photos: Shell

(Left) *The caterpillar of the American bollworm. It does most damage by biting flower buds and young bolls, which then fall off*

(Below) *A cotton boll showing damage*

The Absorption and Translocation of Insecticides applied as Seed Dressings, *by W. A. L. David, Cambridge (U.K.)*

This paper discusses the advantages of the different methods of applying insecticides to seeds and the results which may be expected with different types of compounds. The effect of the size of the seed, the volume of the soil in which it is planted and the rate of watering on the insecticidal action is also considered. Among the insecticides discussed are parathion, schradan, demeton, thimet and BHC.

Toxicity of Dieldrin to the Later Instars of the Desert Locust, *by A. J. A. Pearson, Sittingbourne, Kent (U.K.)*

The toxicity of dieldrin to the later instars of the desert locust *Schistocerca gregaria*, has been determined by a series of dosage mortality studies. The contact action of the insecticide was measured by applying doses of dieldrin to the dorsal surface of the abdomen by micro-syringe, and stomach action by a technique involving the feeding of treated grass 'sandwiches' to individual hoppers.

The Progress of Stalk Borer Control in East Africa, *by P. T. Walker, Arusha (Tanganyika)*

Maize stalk borer is one of the most injurious pests of cereals in East Africa. Increases in yield of maize up to two and a half times are obtainable with insecticides.

Control measures can be divided into those suitable for primitive small-scale peasant agriculture and those employed by larger estates. Derris emulsion has been almost entirely replaced by DDT and endrin, either individually or mechanically applied as dust or spray. Field trials have now proved endrin to be very effective at low rates. Besides accurate application, the timing of applications must be correct.

Some Important Insect Pests of Coconut Palm in India and their Control with Insecticides, *by K. K. Nirula, Patna (India)*

Oryctes rhinoceros is controlled by treatment of its breeding places with 0.01% BHC (13% gamma isomer) and filling of the leaf axils in the crowns of the palms with 5% BHC or chlordane dust mixed with equal quantity of sawdust. Traps consisting of breeding materials treated with 0.1% BHC attract the adults for oviposition, mating and resting, which are killed by the action of the insecticide.

Rhynchophorus ferrugineus is controlled by injecting a 1% dilution of a combination of 1% pyrethrins and 10% piperonyl butoxide into the infested portions of the palm.

Nephantis serinopa is brought under control by spraying the infested foliage with 0.2% DDT.

Leucopholis coneophora Burm., a new pest, the larvae of which feed on the roots of the palms, is controlled by the

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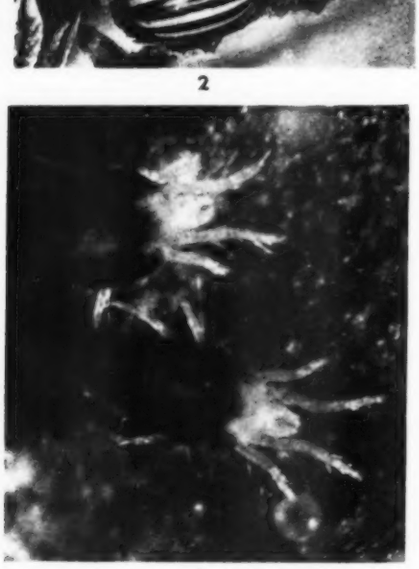

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treatment of the soil in the infected gardens with 5% chlordane dust at a rate of 28 lb. per acre.

Chloropsalta viridissima, *by A. S. Talhouk, Beirut (Saudi-Arabia)*

C. viridissima is a serious grape vine pest in an irrigated area of north-eastern Syria. Directly or indirectly, during the past 15 years the larvae, through sucking the sap from the roots, have wiped out about 17,000 ha. of vineyards, valued at 10 million Syrian pounds ($2,850,000). Larval feeding causes a great weakening of the plants manifested by shorter internodes, smaller leaves and fewer shoots than is normal for the variety. Attacked vines bear small bunches of poor quality.

Adult control of the cicada before egg laying with either DDT or BHC was of some value. Soil fumigation with a solution of para-dichlorobenzene crystals in carbon disulphide, or with dichloropropane-dichloropropene mixture applied with a soil injector in several points covering the area around the vine, gave excellent control of larvae of different ages without killing the vines. Timely pruning of the twigs bearing the oviposition scars will reduce damage. The application of soil insecticides about hatching time is likely to be effective against newly-born larvae.

Metabolism of Insecticides in Insects and its Significance in the Resistance Problem, *by W. M. Hoskins, Berkeley, Calif. (U.S.A.)*

There are many possible mechanisms for resistance to insecticides, but the most important found to date are degradation to a less toxic derivative and storage in non-sensitive tissues. Both are illustrated by data on the resistance to DDT in numerous species. Data are given also on the effect of temperature in the degradation process. On the other hand, some chlorinated hydrocarbons and nearly all organic phosphate insecticides must undergo an alteration process to a more toxic derivative before they are effective. At the same time they undergo detoxification reactions, data for which are given in the case of an organic phosphate.

1. *Larva of the paddy stem borer in a damaged stem*
2. *Colorado beetles devouring potato leaves* (Photos : Shell)
3. *Red spiders and their eggs* (Photo : Plant Protection Ltd.)

Genetical and Biological Studies of Resistance in the German Cockroach and the Large Milkweed Bug, *by J. M. Grayson, Blacksburg, Va. (U.S.A.)*

Results indicate that chlordane resistance in the German cockroach is transmitted by autosomes without the influence of any maternal or sex-linked factors. Apparently many loci are involved and there is evidence that resistance factors exerting some form of dominance might be present.

After 37 generations of selection in the laboratory less than two times resistance to toxaphene and 12 times resistance to DDT had been developed in the large milkweed bug. Only slight resistance to aldrin was shown after 23 generations of selection. Less eggs were produced in DDT strain than normal strain, but numbers of eggs produced in toxaphene and aldrin strains did not differ significantly from normal strain.

MITES AND ACARICIDES

Amiton – a New Acaricide and Scalicide, *by G. L. Baldit, Yalding, Kent (U.K.)*

Amiton is the common name given to a new organo-phosphorus compound – o-o′-diethyl - S - (β diethylamino) ethyl phosphorothiolate – a very powerful acaricide and scalicide. It has been developed commercially as ' Tetram ' (R).

Field tests carried out throughout the world since 1953 have shown that amiton oxalate possesses systemic properties and is very persistent. One application is sufficient to maintain virtual freedom from spider mite and scale attack throughout the season on deciduous fruits, citrus and cotton. At the low rates necessary to control spider mites other insects are not affected, but moderate aphid populations have been eliminated within five days of application and control maintained for three weeks. Amiton oxalate does not affect the predator status and is not phytotoxic.

In common with other organophosphorus compounds, amiton oxalate is toxic to mammals by virtue of its ability to inhibit the enzyme cholinesterase.

Considerable acreages have been sprayed by air and ground machines in sub-tropical countries where little protective clothing can be worn, without any symptoms of poisoning having

been observed. Extensive residue determinations on apples, citrus, cottonseed and grapes have shown that, provided it is applied not less than two months before harvest, at recommended rates, amiton oxalate does not remain in or on the crop in sufficient quantity to constitute a health hazard to consumers.

The Mite Ovicidal Activities of some Chloro - substituted bis-(phenoxy) - methanes and Related Compounds, *by M. B. Green, Dagenham, Essex (U.K.)*

The variation of mite ovicidal activity with number and position of the chlorine atoms in the benzene rings was determined and the nymphicidal and persistent ovicidal activities of the more active compounds were assessed.

The Biology of the Spidermite, *Tetranychus atlanticus, by Z. Düzgünes, Ankara (Turkey)*

This spidermite has so far been reported from the U.S.A., Turkey and Japan. While it is one of the most important pests of apple in Turkey, it has also been found to be a serious pest of low-growing crops, such as cotton, alfalfa, beans, melon, clover, strawberry, parsley and eggplant in the U.S.A. The collection from Japan was made on apple.

Relation between Chemical Structure and Ovicidal and Leaf Penetrating Properties of some New Acaricides, *by J. Meltzer and F. C. Dietvorst, Graveland (Netherlands)*

Among the class of sulphur-linked diphenyl compounds high acaricidal activity is only found in the tri- and tetrachloro derivatives. In particular, the 2,4,5-trichloro and the 2,4,5-4-tetrachloro derivatives are highly active.

The direct contact action on eggs of *Tetranychus urticae*, Koch increases with the rate of oxidation of the sulphur bridge.

Leaf penetration, on the contrary, is most pronounced with the sulphide homologue and least with the sulphone homologue.

Since it appears that the compound with the best leaf-penetrating properties shows the shortest residual action, it seems likely that decomposition within the leaf is the chief cause of the decrease in activity in course of time with this type of compounds.

Damage to stored grain

Untreated wheat after 16 months' storage which has been attacked by grain weevils, Calandra granaria *L., and saw-toothed grain beetles,* Oryzaephilus surinamensis *L. 16.5% of the grains are damaged.*

Wheat which was treated with 'Pybuthrin' grain protectant and stored alongside the untreated wheat for the same period. Less than 1.3% of the grains have been damaged

PROTECTION OF STORED PRODUCTS

Stored-product Insect Research in the U.S. Department of Agriculture, *by R. Latta, Beltsville (U.S.A.)*

The status of current research on protecting stored grain from insect infestation by improvement of fumigation procedures and by development of protective sprays applied directly to the grain is discussed, as well as studies to develop insect-resistant packaging and methods of insect control in food manufacturing, processing and warehousing establishments. Other research on protecting dried fruit, nuts, beans, peanuts, wool, tobacco, dairy products, seeds and rice is reviewed. The status of tolerances for insecticidal residues on raw agricultural products and manufactured or processed foods is presented.

A Provisional Assessment of Malathion for Stored-product Insect Control, *by E. A. Parkin, Slough (U.K.)*

Malathion seems to have a persistence similar to or slightly greater than that of lindane. The outstanding advantage of malathion is its low mammalian toxicity, which is reflected by the Canadian tolerance of 8 p.p.m. in small grains. Also, it has both contact and fumigant effects on insects and can be formulated as dust, water-dispersible powder, oil solution or emulsion. Its toxicity to stored-product insects varies greatly according to the species of test insect, but it is outstandingly toxic to *Oryzaephilus surinamensis* and *Tribolium castaneum:* it is also very toxic to *Calandra granaria, C. oryzae, Rhizopertha dominica, Lasioderma serricorne* and *Stegobium paniceum.* Larvae of *Trogoderma granarium* are less resistant to it than to other insecticides applicable in the presence of foodstuffs.

The Spread of Insects and their Control in the Holds of Cargo Ships, *by E. E. Turtle and J. A. Freeman, Tolworth (U.K.)*

During recent years, evidence has been accumulating on the extent to which insects of stored produce are distributed around the world by carriage in the holds of ships. Not only are insects carried on commodities which are infested when taken on board, but holds of ships acquire infestations which they sometimes carry for many voyages. These infestations can cause clean commodities to become infested and may lead to introduction of species into countries hitherto free. In Britain considerable attention has been paid to the inspection both of commodities coming out of ships and of the holds themselves.

Methods of treatment include fumigating with hydrogen cyanide and with

methyl bromide and the paper summarises the results of measurements made during the use of these fumigants. The use of smoke generators and liquid sprays are also described.

Some Practical Trials of Insecticidal Smokes for Control of the Cacao Moth in Warehouses, *by A. A. Green, Slough (U.K.)*

Trials have been made of DDT and lindane smokes for control of cacao moth, *Ephestia elutella*, in warehouses containing mixed, bagged commodities. Control was assessed by estimations of moth populations. Small bags of cocoa were stored in the warehouse during the period of moth emergence and were exposed to oviposition and any insecticidal treatment. Larvae developing in these bags were counted and the numbers compared with those in bags from a similar but untreated warehouse. Trials were extended over two years. In 1954 DDT was compared with lindane and treatments applied fortnightly. Lindane smoke gave a complete knockdown of moths and left sufficient residual film to keep the population at a very low level. DDT smoke also gave a complete knockdown of moths, but did not leave an effective residual film and allowed the moth population to build up between applications.

Frequency of application must depend, to some extent, on the rate of movement of commodities in and out of the warehouse. Monthly treatments are suggested for closed buildings where conditions are static and more frequent treatments in others.

Piperonyl Butoxide and Pyrethrins Officially Endorsed for Protection of Stored Products in the U.S.A., *by W. E. Dove, Baltimore (U.S.A.)*

Official tolerances have been granted for the presence of 20 p.p.m. piperonyl butoxide and 3 p.p.m. pyrethrins per million parts of such stored grains as barley, buckwheat, corn, rice, rye and wheat. For protection of other stored commodities that require lesser amounts of these insecticides for protection against insects, tolerances are allowed for eight parts piperonyl butoxide and one part pyrethrins per million parts of the food. These include almonds, beans, cocoa beans, copra, cottonseed, flaxseed, grain sorghum, oats, peanuts, peas and walnuts.

The Treatment of Wrapping Materials for Foodstuffs with Pyrethrins and Piperonyl Butoxide for Protection against Insect Infestation, *by K. F. Godwin-Bailey, Berkhamsted (U.K.)*

Following reports from the U.S.A. that foodstuffs could be protected from insect attack if wrapped in materials (jute, cotton, paper etc.) treated with mixtures of pyrethrins and piperonyl butoxide, work was undertaken at the Cooper Technical Bureau to produce a satisfactory product for application to paper. Tests were made with solutions and powders containing various concentrations of pyrethrins and piperonyl butoxide in a ratio of 1:10. The biological activity of the insecticidal deposit on treated papers, both freshly prepared and after storage in daylight and darkness, was assessed by recording 50% knockdown of adult *Tribolium castaneum* after exposure for a set period of time. Mention is also made of a technique designed to assess the value of the treatment in preventing penetration of larvae of the Mediterranean flour moth, *Ephestia kühniella*, into packages. The results described show that paper coated with a powder can retain insecticidal activity for many months and protect certain foodstuffs under semi-field conditions for nine months. Details are given of a field trial where chocolate, packed in cardboard cartons treated with a powder containing pyrethrins and piperonyl butoxide, was protected for a period of six months against infestation of insects whilst in store in East Africa.

INSECTICIDE RESIDUES

Government Regulations and the Development of a New Agricultural Chemical, *by R. G. Aickin, London (U.K.)*

The importance of obtaining maximum food production to feed the increasing world population is recognised by everyone. Agricultural chemicals are indispensable if maximum yields are to be obtained and wastage in storage and transit reduced to a minimum.

Almost all the major developments in this field during the last 20 years have come as the direct result of research carried out by industry. The cost of developing and introducing a new chemical is very high and can easily reach several hundred thousand pounds sterling. Industry can only be expected to invest in this research so long as there is the prospect of obtaining an adequate return from those compounds which reach the market and the costs of development do not continue to increase indefinitely.

The importance of protecting the public against any possible hazards which might arise from the use of chemicals is fully recognised by industry. This public includes all those who may come into contact with the chemical either during its manufacture or application, or through consuming crops which have been treated with it. It is appreciated that national governments, as guardians of the public's health, must satisfy themselves that the use of a chemical in their country does not involve any health hazard or that, if it might, the material is used in such a way that no harm could result. This responsibility leads to the establishment of regulations whose nature varies from country to country in spite of the fact that fundamentally all have the same object in view. In order to conform with all the regulations it is often necessary to repeat scientific work, with or without minor variations, in a number of different countries. Provision of this data adds materially to the cost of developing new chemicals and can well increase the cost to a level where some manufacturers will cease active development in this field.

It is appreciated that certain data, such as that concerning biological or field performance of chemicals, may have to be obtained *de novo* in respect of countries where different conditions exist and this will also include the relevant data on residual deposits of chemicals on the treated crop. However, for a great deal of the data required, it should only be necessary to carry out the work once and in one country. In particular, the chemical characteristics and the toxicology of a new compound will apply everywhere. Industry would be greatly assisted in the development of new chemicals if it were possible to introduce some sort of standardisation in the data required in the various countries. These requirements might well be divided into:

(a) standard data – chemistry, toxicology, the same data being applicable to all countries, and

(b) biological performance and residue data where, although a certain amount of work may have

to be repeated under different conditions, the type of information required is the same from one country to another.

Physical and Chemical Methods for Determining the Insecticide and Fungicide Spray Deposits on Plant Surface, *by J. T. Martin, Long Ashton, Bristol (U.K.)*

The amount of insecticide or fungicide deposited upon a plant depends upon a number of factors. Some plants are easily wetted; others are wetted only with difficulty. The formulation of the insecticide or fungicide is especially important if a high degree of efficiency in spraying is desired.

Physical methods have been used to recover deposits from plant surfaces. Plaster of Paris imprints have been taken of copper and lime sulphur deposits on whole leaves. Thin transparent films prepared from cellulose acetate or nitro-cellulose have been used to pick up deposits of fungicides for microscopic examination. Deposits of materials, such as DDT, have been studied using adhesives, such as gelatine.

In chemical work associated with the physical tests, the distribution of the insecticide or fungicide over the plant surface has been determined by taking tissue of small surface area (1–5 sq. cm.) for analysis. Large numbers of analyses are required.

Methods for the rapid micro-determination of copper, sulphur and DDT on plant surfaces are described.

Insecticide Residues in Olive Oils and Refining Process for Oils containing Parathion Residues, *by M. E. Alessandrini, Rome (Italy)*

The author reports on the research work done by the Italian Superior Health Institute on insecticide residues in olive oils.

Suitable analytical methods have been developed to determine the residues of certain chlorinated hydrocarbons, but chiefly of organic phosphates, and in the first place of parathion. Research has been carried out to eliminate parathion residues from olive oils. The author has developed a process, to be introduced in the refining processes, which makes it possible to eliminate parathion from olive oils even if residues initially reach 200 p.p.m. The oils thus obtained are non-toxic and possess organoleptic characters and physical and chemical properties that are identical with those of oils obtained by normal refining.

Pesticide Residues in Market Samples of Vegetables and Fruit, *by H. J. Hardon, Amsterdam (Netherlands)*

During three years market samples of vegetables and fruit were regularly taken by the Food Inspection Services in the Netherlands.

The spray residues after applying pesticides, such as parathion, DDT, lindane, mercury compounds, zineb and TMTD, which are commonly used by the market gardener in Holland, have been determined. Notwithstanding the widespread use of these chemicals in horticulture, the residues found were small.

These low concentrations are partly caused by the rapid conversion of these pesticides under the influence of the climatic conditions, such as rain and sunshine, and by the rinsing effects of the rain-water.

On the other hand, effective instruction by the extension services is the reason why the gardener has generally followed the advice given for spray concentration and has observed the required period between spraying and cropping.

The Chemical Reactions of some Organo-phosphorus Insecticides in Living Plants, *by G. S. Hartley, Saffron Walden, Essex (U.K.)*

Most systemic insecticides which have been used up till now in agriculture are organo-phosphorus compounds. Translocation in the plant is at best slow, and therefore no compound which is completely destroyed, as is TEPP by hydrolysis, within 24 hours is likely to be of value as a systemic insecticide. All organo-phosphorus insecticides so far found are undesirably toxic to mammals and the possibility arises, therefore, that an otherwise useful systemic insecticide is too toxic and too stable to be used safely.

Since phosphorus has a very convenient radioactive isotope, the radiotracer technique has been applied to the study of the chemical and physical fate of organo-phosphorus insecticides in the living plant.

The identity of the vitally derived compounds has been established by the application of physical methods in conjunction with the tracer technique. The most useful general method is that of partition between immiscible liquids, which can be elaborated into partition chromatography. Measurement of rate of hydrolysis has also been used to help identify a separated fraction.

Two classes of compounds have been investigated. Those in which the stable substituents on the P atom are two NMe_2 groups and those in which the unstable, hydrolysable substituent is $-S-CH_2\ CH_2-SCH_2CH_3$.

Teak Survey in Burma

A study of the market position of Burma teak has just been completed by Mr. M. M. Gallant, an FAO technician, with a view to making recommendations to meet changing conditions. In making his survey, he worked closely with the State Timber Board, an agency of the Burmese Government responsible for the extraction, milling and export of teak.

Up to the last war Burma was the leading exporter of teak in the world, providing as much as 85% of the world supplies of this wood. In the immediate post-war years, however, Thailand took the leading position by heavily over-cutting its forests, but it is expected that Burma will soon resume its former leading position, though the volume of her exports will only amount to 60% of that in pre-war years. On the other hand, the total availability of this wood in world markets is at present only 47% of the pre-war figure and, according to Mr. Gallant, this reduction is likely to be permanent.

This change in the marketing pattern is now causing serious concern. High grades of teak will always have a sure and permanent market in Europe; but these high grades only represent 30% of total production and the problem is to dispose of the remaining 70%, which before the last war were readily absorbed by India and Pakistan. Scarcity of foreign exchange in these countries in recent years has reduced imports to one-fifth of the pre-war volume and, as it is improbable that new markets can be found elsewhere, the surplus teak will have to be used in Burma. Mr. Gallant considers that the present mill potential is sufficient to deal with this excess if the existing plants are modernised.

Residues of Pesticides in Foodstuffs

The Need for Standard International Legislation

A SYMPOSIUM to discuss the important question of pesticide residues on foodstuffs was arranged recently at the new headquarters of the Society of Chemical Industry in London by the Pesticides Group of the Society.

Dr. F. P. Coyne, who presided over the meeting, said that, whereas the early pioneers had unfettered opportunities to develop a new crop-protecting chemical, today manufacturers are frustrated by a host of laws and restrictions, which vary with different countries. It was the duty of a government to impose regulations, but he considered that the regulations should be of reasonable simplicity and of international application. The situation was indeed complicated by the fact that there were one set of rules regarding the application of pesticides and another, quite unrelated set, under the Pure Foods Act.

One speaker pointed out that under existing conditions it costs up to £250,000 and it takes about four years to introduce a crop-protecting chemical; of this, about £20,000 is spent on testing the new product. It would, he said, be a serious situation if industry decided that the cost was too great and the money could be used more profitably in another field.

In the subsequent discussion, Prof. Sir Solly Zuckerman pointed out that it was not possible to define the hazards and that there were, as yet, no known or proven cases of poisoning due to pesticide residues on foodstuffs. There are so many factors that it is not possible to isolate a symptom and say definitely that it is due to the pesticide. Pharmacology, he observed, is still only an empirical science and it is not always practicable to define what should or should not be done owing to the wide variety of conditions and the difficulty of measuring trace amounts and of obtaining agreement on the best method of analysis. The sooner there is uniform international action the better, he concluded.

The following is a brief summary of the papers:

Existing Regulations in the U.K. and Overseas, *by J. I. Hendrie* (*Shell Petroleum Co. Ltd.*).

The introduction of new pesticides is becoming subject to more and more Government regulations all over the world. These regulations are mainly designed to protect the public from possible harmful effects.

Industry recognises its responsibility and will itself carry out adequate investigations into new compounds so that it can make proper recommendations for their use. Governmental authorities are inclined to demand complete data regarding all possible applications of a new compound when in many instances industry believes that data obtained on one crop or in one country can be used as the basis for approval on other crops or in other countries.

The effect of excessive regulation is to increase the cost of developing new compounds and to make it impossible to develop new and possibly unexpected applications for an existing material quickly.

Pesticide Residues and Public Health, *by E. F. Edson* (*Fisons Pest Control Ltd.*).

There has thus far been an almost negligible occurrence of detected ill effects from pesticide residues in human foods and there would appear to be no grounds for active apprehension.

However, previous experiences in public health and industrial medicine imply that relaxation of present standards of caution by manufacturers, toxicologists or Government officials could permit risks of injury to occur.

There are important limits as to what can be proved by toxicological testing methods using animals. The interpretation of their results in terms of public health also presents great difficulties.

Exposure of the public to an increasing number of industrial and agricultural chemicals is likely to necessitate more toxicity testing using increasingly refined techniques to exclude the less obvious risks, and thus to cost more in money, time and patience.

The interests of Government public health advisers and the industrial concerns do not always coincide, and can best be met by increasingly close collaboration and mutual assistance on matters of both general principle and scientific detail.

The present situation appears to justify caution, and the search for factual information on pesticides' toxic effects and on the degree of exposure of the public to pesticide residues in foodstuffs.

Determination of Residues, *by J. M. Winchester* (*Plant Protection Ltd.*).

The evolution of an analytical method for the basic chemical, the development of satisfactory processes for the extraction of residues of the chemical from plant materials and the determination of these residues in quantities amounting at times to no more than a fraction of a part per million, are time-consuming and expensive. It is necessary, therefore, to ensure that the methods of spraying the crop and the sampling of these portions to be consumed be planned, if necessary, in collaboration with those authorities who are the final arbitrators.

Difficulties have been met in the past in obtaining agreement between analysts on details of methods. It is preferable, therefore, that the method developed for a compound should be one that can be satisfactorily used by other workers.

Pea Growing Research

Associate membership of the Pea Growing Research Organisation is now open to anyone associated with the pea industry, including growers of all types of peas and manufacturers or suppliers of machinery, sprays, fertilisers etc.

The Organisation employs a qualified staff and has its own research station at Yaxley, Peterborough. The current research programme includes investigations of improved seed dressings; seed and soil treatment for pea weevil control; pea root eelworm studies; organisation of machinery demonstrations; examination of chemical bird repellents; chemical control of wild oats and trials of new varieties of peas for canning and quick freezing.

Associates will be entitled to free advice, invitations to visit field trials, demonstrations and conferences and will receive copies of all the Organisation's publications and technical reports. Enquiries should be addressed to the Pea Growing Research Organisation Ltd., Agriculture House, London, S.W.1.

WAR AGAINST HUNGER

3rd World Fertiliser Congress at Heidelberg

In the short period of only 50 years, the production of fertilisers has grown from very small beginnings into a mighty industry, and it is still growing, both in size and importance. Their increased production and equitable distribution will be a potent factor in the maintenance of world peace.

THE 3rd World Fertiliser Congress began auspiciously in the Emperor's Hall of old Heidelberg Castle to the strains of music from the period of the Elector, Prince Ottheinrich, rendered by the Municipal Orchestra, conducted by Herr Hermilink, Director of Music at the University.

Prof. Ludwig Schmitt, of Darmstadt, Germany, President of the Congress, then gave his address of welcome to the delegates of 35 nations – some 750 in all. He began by reminding those present of the historical link which made Heidelberg an especially suitable meeting place, for it was on the Bergstrasse that the eminent scientist, Justus von Liebig, began his career, and it was at Darmstadt, only a few kilometres distant, that German chemists had given such impetus to the advancement of fertiliser science; also in the vicinity were the Ludwigshafen works of Haber and Bosch.

He described the Congress as an 'Olympiad of science and technology', uniting the peoples of the world, where the results of a century of scientific research into the production, distribution and methods of application of fertilisers was to be discussed for the benefit of all nations.

Some countries, he said, had an excess of food, but, for geographical reasons, it was difficult to distribute the surplus. It would be far better to increase production in the under-developed countries by the increased use of fertilisers.

For example, the world production of potash had now reached the colossal figure of 6.2 million tons, which is produced mainly in France and Germany, but there were serious distribution difficulties because of currency shortages, and as a result the consumption of potash for comparable acreages was 18 times greater in Germany than in the under-developed countries.

Introduced by a beautiful song, 'Herzliches Bild' (1540), the Nobel prize-winner, *Prof. Artturi Virtanen* (Finland), then gave the opening address, entitled 'The Technique of Manuring Considered in the Light of Modern Nutritional Research', of which the following is a summary:

Even in our highly industrialised world, agriculture is still the foundation upon which the life of mankind depends. Where food is absent, any other kind of production is meaningless. No further argument is necessary to establish the pre-eminent position of agriculture in world affairs.

The distinguished scientist, Prof. Artturi Virtanen, of Finland, who gave the Opening Address

As it is the purpose of agriculture to supply wholesome food of the greatest possible value to man and the domestic animals, it must of necessity work in close contact with nutrition research and must closely follow new developments in this particular field. We know as a result of laborious and difficult research work that *man needs about 40 precisely-defined food factors. These are some 25 organic compounds, viz. eight amino acids and about 17 vitamins, while about 15 of these factors are mineral elements.* A diet must contain all these substances in adequate amount to be fully satisfactory from a health point of view. Although most of them are required in small and even in positively minute amounts – the daily vitamin B_{12} requirement of man, for example, is only one thousandth of a milligramme – *life becomes impossible if even a single one of these substances is completely absent.*

Differences in nutrient values

An adequate and balanced supply of the nutrients needed by men and animals is vitally dependent upon *the chemical composition of the cultivated plants. This may be very different for different plant species. In different varieties of the same species considerable differences may even be found* in regard to the content of individual nutrients. *The content of essential nutrients, even*

of one and the same plant, often varies to a surprising extent at different stages in its growth. Numerous growth factors considerably influence the chemical composition and thereby the nutrient content of plants.

It is to the credit of Justus von Liebig, the great German chemist and founder of modern agricultural chemistry, that he recognised the importance of the mineral nutrition of plants and drew practical conclusions from his results. By introducing fertilisers into agriculture he laid the basis for the intensive production of crops, which, in turn, has made it possible to feed a rapidly increasing human population. As far as feeding mankind goes, we would today be in a hopeless position without the so-called artificial fertilisers produced by a fertiliser industry, which has now grown to mighty proportions.

Need for balanced manuring

Every thinking person, who does not wish to deny facts for reasons of faith, must accept in principle the idea that available farm manures must be supplemented by chemical fertilisers to such an extent that the nutrient requirements of any given crop are met as fully as is possible. Only in this way is it possible to avoid a lack of nutrients in plants and achieve a balanced optimum level of manuring.

As is already known from previous research work, an optimum balanced complete manuring will yield crops containing the maximum amounts of those organic nutritional factors (the amino acids and the vitamins) indispensable for man and animal. This shows that we have fortunately taken the right path in modern methods of manuring.

Importance of trace elements

But new and important points of view with regard to the problem of manuring have been expressed in recent years as a result of observations, made in different parts of the world, concerning the importance of the so-called trace or micro-elements for the growth of plants and also for the feeding of man and, in particular, the feeding of farm animals. It is important to add the deficient micro-elements with the major plant foods in order to ensure good yields so that the resulting crops, and consequently the food of men and animals, will contain all these substances in adequate amount. It is, therefore, of great importance that the farmer should utilise, as far as possible, the micro-elements present in farmyard manure in order to eliminate a deficiency of micro-nutrients.

The maintenance of the fertility of our soils by a suitable rotation of crops and by farm manures, combined with the supply of the deficient nutrients in the form of commercial fertilisers, will undoubtedly guarantee the production of the most nutritious food for men and animals. The proof that a number of micro-elements are essential nutrients, as much for men and animals as for plants, and the fact that these elements are now classed among the fertilisers represents a tremendous advance in our manurial methods in extensive regions of the world. Continuous and ever more intensive researches in the field of agricultural chemistry, plant physiology and particularly nutrition will doubtless lead to further improvement in our manurial methods, but it is clear that these will be based on the existing scientifically well-established foundations, he concluded.

The subsequent proceedings were arranged in four sessions. The lectures, as well as the discussions which followed each paper, were translated simultaneously into three languages – German, French and English – and the delegates arranged themselves in groups of two at each of the headphones, which arrangement also provided an effective introduction between the delegates.

It is intended to publish the lectures also in three languages and advance orders may be placed with the German Organisation Committee, 3rd World Fertiliser Congress, Darmstadt, Rheinstrasse 91, Germany. The following is a summary of the proceedings:

Fertilisation and Farm Management

President: Prof. R. Braconnier (France).

1. ' Mineral Fertilising as a Basis for the Transformation of Natural Soils into Cultivated Soils ', *by Prof. Schuffelin* (*Netherlands*).

2. ' Mineral Fertilising and Humus Husbandry of the Soil ', *by Dr. G. Barbier* (*France*).

Use and Production of Fertilisers

President: Dr. Herren (Germany).

1. ' Progress in the Production of Fertilisers During the Last Ten Years', *by Dr. G. Fauser* (*Italy*).

2. ' Economic Effects of Our Present Methods of Fertilising ', *by Prof. G. Blohm* (*Germany*).

3. ' Fertilising Problems in Various Parts of the World ', *by Dr. K. A. Bondorff* (*Denmark*).

Mineral Substances in the Life of the Plant

President: Prof. G. Torstensson (Sweden).

1. ' Physiological Effects of the Macro-Nutrients ', *by Dr. H. Linser* (*Austria*).

2. ' Functions and Effects of the Micro-Nutrients ', *by Prof. K. Scharrer* (*Germany*).

The Effect of Fertilisation on the Nature of the Agricultural Products

President: Prof. O. T. Rotini (Italy).

1. ' Fertilisers as Factors in Improving the Quality of Plant Products ', *by Dr. D. J. D. Nicholas* (*U.K.*).

2. ' Fertilising and the Feeding and Quality of Animal Products ', *by Prof. K. Nehring* (*Germany*).

Closing Ceremony

President: Dr. E. Feisst (Switzerland).

1. ' The Influence of Our Manurial Techniques on Soil Fertility During the Last Hundred Years ', *by Prof. L. Schmitt* (*Germany*).

2. Decisions reached at the Conference.

Scientific excursions were arranged to give practical demonstration of subjects dealt with at the Congress. These consisted of visits to the vineyards and forests of the Palatinate and to research institutes, factories and various other places of interest to the delegates.

The Palatinate has a total area of 1.35 million acres, of which half a million acres is under forest, the largest single area of forest in West Germany and consisting mainly of beech (*Fagus sylvatica*) and spruce-fir (*Picea excelsa*). Successive generations of beech have decreased soil fertility; the soil has become sour and is deficient in lime and minerals. The fertilising practice was demonstrated.

Lime is applied in the form of powdered chalk ($CaCO_3$) by means of a blower which spreads the material into the forest a distance of some 40 to 60 yd., depending on the denseness of the foliage. There are some 35 of these machines now in use. The rate of application is from 24 to 48 cwt. per acre, according to the soil reaction.

Agriculture in Canada

Land of Vast Resources

Four centuries have seen Canada grow from a handful of scattered fishing settlements and trading posts into a modern industrialised state of over 16 million people, covering half a continent, and now ranking fourth among the trading nations of the world.

The greater part of the country is covered with trees which form the basis of an enormous lumber industry and her farmers produce vast quantities of wheat. Less generally known is the fact that Canada has the biggest uranium industry and will shortly have the largest potash fertiliser industry in the world—both pointers to the future.

THE earliest explorer of Canada was the Venetian, John Cabot, who reached the coast in 1497, sailing under the English flag. In 1534 Jacques Cartier, of France, discovered and explored the St. Lawrence River and, incidentally, was responsible for Canada's name. On asking the Indians what country lay beyond, they replied 'Kanata', which he took to be the name of the country, but which has since been believed to have meant an Indian village further up the St. Lawrence. The opening of the country was begun by Samuel de Champlain in 1605, and for a century and a half the development of 'New France' remained chiefly in French hands.

The economy of Canada during this period was built on the fur trade. The Hudson's Bay Company, from its foundation in 1670, entering Canada through the sea which bears its name, laid active claim to the vast territories of the Hudson Bay watershed. In 1763, the Treaty of Paris gave all French territories in Canada to Great Britain. The Quebec Act of 1774 secured for the French remaining in Canada their language, religion and civil law.

In 1867 the provinces of Ontario, Quebec, Nova Scotia and New Brunswick united in a federation, the name Canada being thenceforth applied to the country as a whole. Manitoba entered this confederation in 1870, British Columbia in 1871 and Prince Edward Island in 1873. In 1905 two new provinces, Alberta and Saskatchewan, were carved out of the prairies. Newfoundland became the tenth Canadian province in 1949.

Canada is unique in the western hemisphere in being a kingdom among republics. As a sovereign nation of 10 provinces and two territories, it is likewise unique in that it is founded on British principles of parliamentary government which, while combining monarchial forms with democratic practices, have been adapted to the needs of half a continent through the application of the federal principle. The 10 provinces are united under the Federal Government, which controls matters concerning the country as a whole—such as defence, trade and commerce, banking, transportation and external relations. The provincial governments have authority over such matters as education, property laws and health.

Types of climate

A country as vast as Canada, extending from the Atlantic to the Pacific Ocean and from latitude 42°N to the North Pole, has, of course, many types

A herd of 3,000 cattle on a 5,400-acre ranch in Saskatchewan being rounded up for inoculation, spraying and branding

An aerial view of the cultivated countryside near Lethbridge, Alberta, showing the system of irrigation ditches so essential in this part of Canada

of climate. The variations are due not only to contrasting physical features, but also to differences in latitude and in distance from the sea.

Vancouver Island and the British Columbia coast enjoy the mildest climate in Canada. The winters are seldom cold, but winter rainfall is heavy. The summers are long and moderately warm. The climate of the interior is dry with cold winters and warmer summers than on the coast.

In the Prairie Provinces, the winters are cold and bright, although Alberta, affected by the Chinook wind, often has sudden thaws and warm winter days, particularly in the south. In the summer, the days are warm and the nights pleasantly cool. Northern Ontario has cold winters and warm summers. The southern parts of the province bordering the Great Lakes have a more temperate climate. In northern Quebec winter temperatures drop as low as 50°F below zero. The weather of the southern parts of the province is more temperate. The Maritime Provinces have varied temperatures, often accompanied by a high wind and abundant rainfall. The summers are usually quite warm.

The wide open spaces

Canada's 3,845,774 *square miles makes it the second largest country in the world.* Almost one-half of Canada constitutes the Canadian Shield, most of which is unsuitable for agriculture, but rich in forests, minerals and water power. This area produces most of Canada's gold, silver and copper. West of the Shield lie the interior plains, stretching across southern Manitoba, Saskatchewan and Alberta, north through the valley of the Mackenzie River to the Arctic. The southern part of this region, known as the Prairies, is the great Canadian wheat belt. The remainder of the area is largely forested and has extensive deposits of oil and natural gas. The land rises from east to west and, in the higher and rougher parts, cattle-raising is an important occupation. The Canadian Rockies stretch eastward 400 miles to the Pacific coast. The interior of British Columbia has many plateaux and fertile valleys, famous for cattle ranching and orchards.

Vast water resources

Canada, with about one-third of the world's known fresh-water area, is fortunate in having not only the natural resources to implement the irrigation schemes that are necessary, but, as much of it descends from high altitudes, she also has abundant water power. *These rivers now produce over* 18 *million h.p.* (more *per capita* than any other country except Norway) *and nearly four times as much remains unharnessed.* Irrigation has, indeed, played a major part in the development of Canada's agricultural resources. In the interior mountain valleys in southern British Columbia, irrigation has transformed a virtual desert into the richest fruit-growing area in Canada. Irrigation canals bring water to approximately half a million acres in southern Alberta and to smaller areas in Saskatchewan. Under irrigation, a prosperous sugar-beet industry has grown up in Alberta.

Millions of tons

Agriculture is Canada's most important primary industry and approximately one-fifth of commodity production in Canada comes from the agricultural industry. Over three million Canadians live on farms which average 308 acres in size. The total area occupied by farms exceeds 271,000 square miles, of which about 125,000 square miles are now under cultivation. Nearly three-quarters of all occupied farmland in Canada is found in the Prairie Provinces of Manitoba, Saskatchewan and Alberta. Peculiar conditions of soil and climate make this one of the greatest grain-growing regions in the world. *Wheat production is the main industry in the Prairie Provinces and wheat is the most important Canadian crop entering world trade. In* 1956 *the wheat crop totalled* 537.8 *million bushels*, while other grains (oats, barley, rye, buckwheat etc.) totalled 23.4 million tons. In addition, Canada produced a huge fruit crop, which included over 19 million bushels of apples, over 22 million quarts of strawberries, 25 million lb. of honey, and over 2½ million gal. of maple products.

In June 1956, Canadian farms were maintaining nearly 10½ million cattle (of which nearly 3,348,000 were dairy cattle), 5½ million pigs, and 68 million head of poultry. These between them produced 1,139 million lb. of beef, 1,119 million lb. of pork, and over 443 million lb. of poultry meat.

Canadian farmers effected major changes in land use in 1957; continuing the pattern of the past three years, the acreage planted with wheat was the smallest since 1943–44, when there was a special war-time acreage reduction. With this exception, the acreage last year, *viz.* 20 million acres, was the smallest since 1920, but *though the acreage was reduced, total production was higher.* This was the result of improved methods of agriculture.

The secret of success

The Government of Canada assumes a major role in agricultural research and experimentation through the Experimental Farms Service of the Department of Agriculture. As an indication of the importance with which their work is regarded, an official of this department said, ' The growth of Canada's export trade and the growth of importance of Canada as a nation both date from the day the experimental farms perfected a wheat that would ripen before the frost. Marquis wheat turned thousands of struggling homesteaders into prosperous farmers. It turned thousands of struggling businesses into thriving ones '.

Over a period of 60 years, the Government has established a chain of experimental farms and laboratories, stretching right across the country. They are located so as to serve the needs of a wide variety of farming enterprises and of specialised areas of soil and climate. These institutions conduct scientific research on methods of pest and disease control, the microbiology of soils and foodstuffs, the nutritional requirements of plants and animals, and the development of superior types of plants and animals. Long-term investigations are conducted on the effects of various agricultural methods on soil fertility and erosion. The mechanisation of farm operations is considered, not only in its relation to farm efficiency, but also in its effect on soil and moisture conservation.

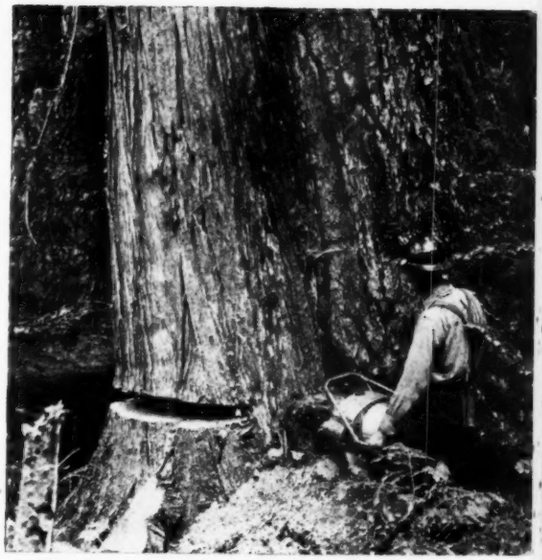
Laboratory research is directed towards the control of disease in livestock, the control of insect and fungus pests of crop plants and forest trees, the improvement in techniques for the processing and storage of farm products, the application of genetics in the development of superior strains of plants and animals and many other problems.

Economic research into problems of farm management, land utilisation, produce marketing and domestic problems of farmers is also carried out and each province maintains an effective agricultural advisory service, usually located by counties or districts.

Forest wealth

In addition to fulfilling her own requirements, *Canadian forests supply over* 80% *of the total free world's export of newsprint* and 29% of its lumber. It is realised that, while Canada's forest reserves are great, they are not inexhaustible, and the methods of conservation are designed to increase her reserves. This industry employs approximately 360,000 workers.

Most of the forestry research in Canada is carried out by the Department of Northern Affairs and Natural Resources. The responsible divisions of the Department deal with forest economics, silvicultural research, forest fire protection investigations (about 6,000 forest fires are reported each year), air surveys and forest products research. For protection of forests against injurious insects and tree diseases, the provincial forest services co-operate with the Forest Insects Division and Forest Pathological Division of the Federal Department of Agriculture, although one province also maintains its own entomological and pathological service.



Felling a giant cedar in British Columbia with power saw. The moist and equable climate of the coastal areas produces a luxuriant growth of conifers

The future

Economists have estimated that Canada could support a population of 60 million people. As a result of the increased yields per acre made possible by research, it is confidently expected that Canada will not only be able to feed her growing population, but will continue to produce an exportable surplus of foodstuffs to meet the increasing needs of an ever-expanding world population.

An extensive fruit orchard in the Okanagan valley of southern British Columbia. The apples grown here are of particularly fine quality

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To Authors and Readers

The publishers of WORLD CROPS invite the submission of manuscripts of books to be considered for publication. All manuscripts will be promptly acknowledged and carefully considered by qualified experts. A synopsis with chapter headings should be sent in the first instance, addressed to the Book Production Manager.

The publishers are specialists in industrial, technical and scientific books and have a world-wide selling and distributing organisation.

The Sokoto Rice Scheme

F. O. BRICE-BENNETT

The story of the growth of the Sokoto rice scheme in the Northern Region of the Federation of Nigeria tells of some of the problems which make agricultural development in Africa so difficult

THE Sokoto River, a tributary of the Niger, flows through a vast valley which, after the rains, floods along some 250 miles of its course. These floods, which rise to a height in places of 10 ft., create enormous marshlands covering about 350,000 acres and deposit a rich silt.

The valley has for long attracted the attention of agriculturists, but, due principally to poor rains, but also because the land quickly lost its fertility, it was found that much of it was unsuitable for extensive cultivation of any crops other than rice. Thousands of acres have been cultivated by the inhabitants for generations with a variety of red rice which has adapted its growth to the deep floods, and, since other crops do not prosper there, this now forms the staple diet of the people.

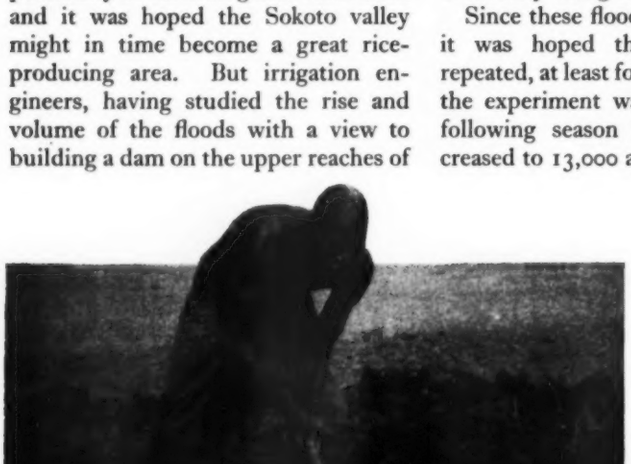
A rice mission visited the area in 1948 and reported favourably on the possibility of extending this cultivation and it was hoped the Sokoto valley might in time become a great rice-producing area. But irrigation engineers, having studied the rise and volume of the floods with a view to building a dam on the upper reaches of the river, reported that control would cost several millions of pounds and, at least for a time, this idea had to be abandoned.

Initial setbacks

Nevertheless, the Northern Regional Department of Agriculture experimented with 70 acres which yielded a sufficiently satisfactory harvest of rice to justify extending the experiment. The Northern Region Production and Development Board (now the Development Corporation) was approached and agreed to finance the scheme and also to provide the supervisory staff. Caterpillar D7 tractors and disk ploughs were introduced and in November, 1949, some 2,250 acres were ploughed. Unfortunately, even before sowing had been completed, phenomenally heavy floods washed out many of the younger plants and resulted in almost complete failure, only about 30% of the crop eventually being harvested.

Since these floods were exceptional, it was hoped they would not be repeated, at least for many years, and so the experiment was continued. The following season ploughing was increased to 13,000 acres and, with good rains and normal floods, yielded 1,200 to 1,500 lb. of paddy per acre. With so favourable a year many more farmers were eager to join the scheme and in the third season there was a further increase to 25,000 acres. That year the rains failed.

In 1953 26,000 acres were ploughed. This time early rains and premature floods submerged the young and immature shoots and destroyed most of the crop. This made three bad seasons against only one good one.



A small farmer hoeing by hand with the traditional implement

Reorganisation

After so many disappointments, farmers who had from the beginning been dubious of the experiment withdrew; indeed, some who had looked with superstitious awe on the introduction of mechanised ploughing actually attributed the vagaries of the weather to this novel method of cultivation and did their best to discredit it among their neighbours.

In the end, after reorganisation, it was found that the majority of farmers still willing to continue lived within the Gwandu Emirate, and the native authority there took over the scheme. The Production and Development Board made an outright grant of the remaining financial assets, amounting to approximately £53,000, and further

A panorama of the area where the scheme is in progress taken from a hilltop near Birnin Kebbi

subsidised the scheme by providing the entire European supervisory staff.

Before reorganisation the staff, with their limited equipment ploughing in scattered areas, was forced to do a considerable amount of night ploughing with a consequent loss in efficiency. Now that the acreage has been reduced and is less widely scattered, ploughing is more concentrated so that more detailed development can be given to the scheme.

Bunds have been thrown up at strategic points in an endeavour partially to mitigate the flow and intensity of flood waters over the lower-lying ground. Elsewhere channels have been dug to divert water into areas not normally flooded at the beginning of the rains.

In 1954 only 8,280 acres were ploughed and some 9,850 last year. Both seasons were good and the total yield of paddy was approximately 18,000 lb. This year it is estimated that 5,000 farmers will subscribe to the ploughing of nearly 10,000 acres.

Success

The cost of mechanised ploughing to farmers is 55*s*. per acre and in a good year an acre will yield an average of at least 1,000 lb. of paddy. Thus, at the present market rate of £20 per ton, a farmer can make a gross profit of nearly 300%. Few cultivate less than two acres, and one or two larger farms extend to more than 20 and their profits could be quite considerable.

Obviously it is quite uneconomic to plough small pockets of land, and farmers are urged to pool their farms. Unfortunately, many farms are too distant from the general scheme and, although an exchange of land has been offered to farmers, they are loath to foresake their land, fearing that, should they at some later date want to retract from the scheme, they would not be allowed back on their old farms. If this problem could be solved and all land pooled to form one ploughing area, costs would be considerably reduced.

The future

The scheme does not—nor is it intended that it should—make large profits. It at present covers costs and endeavours to create a reserve, but it is indebted to the extent of some £28,000, which is at present a charge on its reserves, principally because ploughing charges to the farmers are too low. Since such charges can only be based upon what the farmers are prepared to pay, the difference is charged to production development. On this basis the scheme can continue only until its machinery and resources are exhausted.

When this stage is reached the project will either have to be abandoned or, according to the ability of the native authority to finance it and the willing co-operation of the farmers, reorganised on a sounder financial basis.

On the whole, the project, which must still be considered experimental, has not been unsuccessful. If it can become an established undertaking, it should prove of great significance to that part of Northern Nigeria by providing increased acreage for the production of rice.

Where small farms are pooled, mechanised ploughing becomes economic

Comparative Mobility of Labelled Herbicides in Plants

PROF. A. S. CRAFTS, *University of California, U.S.A.*

The use of radioactive tracers in herbicide research

STUDIES using labelled 2,4-D in a variety of plants have shown that this chemical enters the leaf through intact cuticle, migrates across the mesophyll, and moves with assimilates in the phloem, providing translocation is rapid. Both rapid movement and active growth seem to be essential to successful action of the 2,4-D type of herbicide.

Movement of 2,4-D takes place readily from green to chlorotic leaves of variegated *Tradescantia* plants; it fails to move out of chlorotic leaves; it by-passes mature active leaves *en route* from a mature active leaf to sinks in growing roots or growing shoot tips. It may move acropetally, basipetally, or both ways, depending upon the relative activity of sinks and location of the treated leaf. Movement will take place into a shaded shoot if growth is active; illumination reverses this movement.

Treatment of mature *Zebrina* leaves growing midway on long branches with labelled 2,4-D, amino triazole (ATA) and maleic hydrazide (MH) proved that 2,4-D was the least mobile of the three, ATA was intermediate, and MH was the most freely mobile. In these mature shoots 2,4-D remained localised in the treated leaves and the adjacent stem; ATA moved into the roots and into shoot tips, by-passing mature leaves along the way; MH moved into roots and shoot tips and also into all intervening mature leaves. Similar distribution was obtained by treating internodes of similar plants. The 2,4-D was apparently accumulated by living cells before it had opportunity to move in the phloem; ATA moved to sinks in roots and shoot tips and was limited to the phloem; MH moved freely in the phloem and apparently leaked into the xylem, whence it moved into active leaves via the transpiration stream; possibly it circulates in the plant like phosphate.

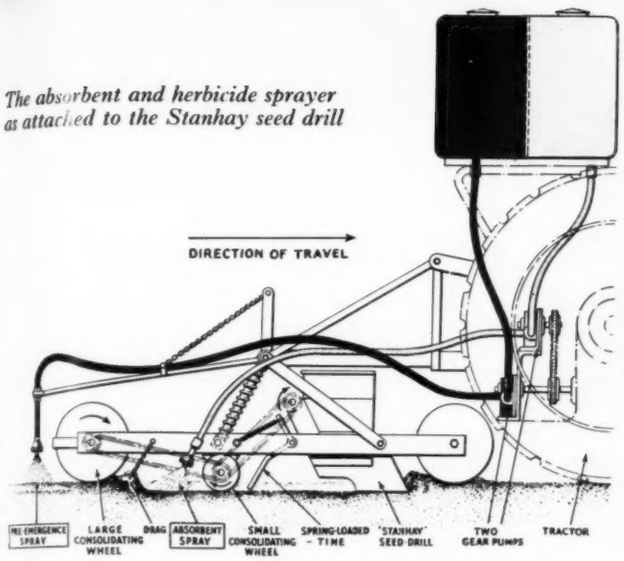
Comparative tests using labelled 2,4-D, 2,4,5-T, ATA, MH, monuron and urea in barley seedlings showed that urea, MH and ATA are freely mobile, moving throughout the roots and entering active untreated leaves; 2,4-D and 2,4,5-T moved freely to the crowns, but went into root systems in very low concentration; monuron moved only from the treated spot to the tip of the leaf; apparently it does not enter the phloem. A similar comparative trial using potato tuber tissue showed that 2,4-D and 2,4,5-T are accumulated in living cells near the region of application, ATA moves into a somewhat larger area, MH moves even farther, and monuron spreads throughout the block of tissue.

Studies comparing labelled 2,4-D and dalapon (sodium-2,2-dichloropropionate) prove that these compounds attain a similar distribution in barley seedlings; apparently both are subject to retention by active living cells; they fail to pass the intercalary meristems of growing leaves, but will move into roots from very mature leaves.

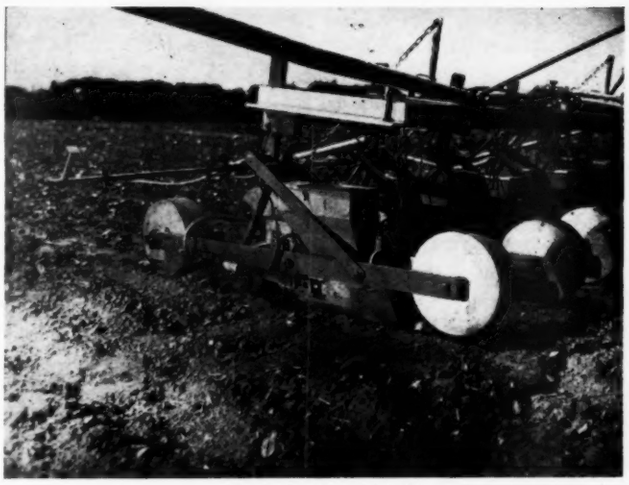
Our studies apparently indicate that dinitro compounds, chlorophenoxy compounds and chloroalkyl acids enter plants as the undissociated parent molecules through cuticle; they are subject to strong accumulation by active cells; they are freely translocated in the xylem following absorption by roots; phloem transport is the resultant of contact toxicity, accumulative activity and rapidity of assimilate movement. Dinitro compounds are too toxic to enter the phloem in quantity; 2,4-D and dalapon are subject to active accumulation, and in the absence of very rapid assimilate movement they are not effectively moved into roots.

ATA, MH, monuron and urea also move freely in xylem; they enter leaves via an aqueous route; in phloem ATA, MH and urea move freely and under some circumstances seem to leak into the xylem and hence to circulate. Monuron moves freely in xylem, but seems not to enter the phloem; possibly its movement is limited mainly to the apoplast.

Uptake and distribution of 2,4-D, amino triazole, and maleic hydrazide by Zebrina plants as shown by autoradiographs of treated plants. The autographs are on top; the plants are shown below. The black arrows indicate the treated leaves, three on each plant. Total dosage was 0.5 micro-curies per plant. The treatment time from application to killing plants was four days. The plants were freeze-dried. Exposure of the plants on the X-ray film was four weeks.



The absorbent and herbicide sprayer as attached to the Stanhay seed drill



Selective Weed Control for Related Plants

W. E. RIPPER, Ph.D., F.R.E.S.

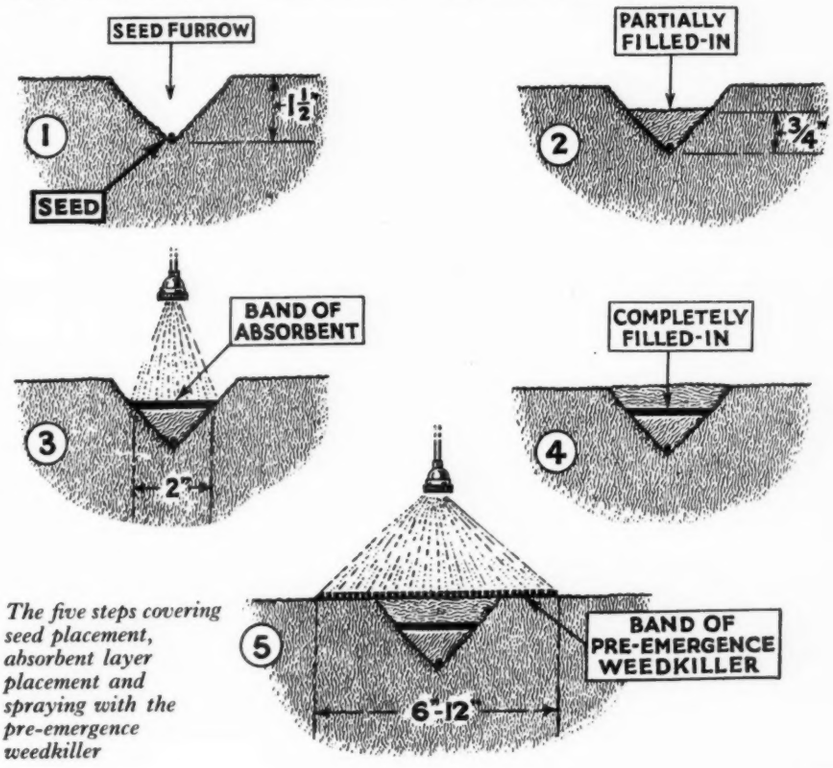
No one has yet discovered a weedkiller which can distinguish between plants of the same type, e.g. broad-leaved weeds with beet, or grass in cereals. An interesting new technique and special equipment to effect selective control is here described.

AN increase of the selectivity of marginal pre-emergence weedkillers has been obtained by placing a barrier of active carbon in the soil above the seed, but below the depth of the germination of the majority of the annual weeds, so that the seeds of the crop will have time to germinate and grow in soil uncontaminated by the pre-emergence weedkillers, until the germinating weeds above the absorbent layer have been killed and the weedkiller is attenuated to a concentration no longer phytotoxic to the young crop plant when it emerges through the absorbent layer.

For this purpose a seeder and absorbent herbicide sprayer has been developed which accomplishes the following tasks in one agricultural operation: (1) a seed furrow is opened and a seed placed therein, (2) the seed furrow is partly filled in and the soil consolidated, (3) a narrow band of an active carbon suspension is sprayed on the partly filled in furrow, (4) the furrow is completely filled in and consolidated, and (5) a band of pre-emergence weedkiller is sprayed on the top of the soil.

This allows the cereal seed to germinate and grow in the uncontaminated soil while the germinating weeds in the sprayed soil above are being killed. The young beet plants break through the protecting absorbent layer later when the herbicide, by evaporation, decomposition or dilution, is no longer toxic to the crop.

Concurrently with laboratory investigations into the phenomena which led to phytotoxic effects on marginal pre-emergence selective herbicides, improved prototypes of the seeder-absorbent-herbicide sprayer were developed and field-tested on beet, peas, beans, wheat and rape with IPC, EPTC, endothal, Baron, dalapon, TCA, 2,4-D and MCPA used as herbicides. Logarithmically variable dosages of absorbent and herbicides were applied. The selectivity of carbamate and plant hormone weedkillers against susceptible crops was increased by a carbon layer above the seed. The results of the investigation showed that for several hitherto intractable weed problems, such as broad-leaved weeds in beet and rape and annual meadow grass in wheat, a chemical control with absorbent placement over the crop seed is now practicable.



The five steps covering seed placement, absorbent layer placement and spraying with the pre-emergence weedkiller

Pests of Cotton

Cotton has been cultivated for some 3,000 years and through the ages some 20% of the hard work expended by the farmer has gone to feed the insect pests to which it is prey. That is to say, world cotton production in an average year is well over 30 million bales, but the annual toll of the insects is between 7 and 8 million bales.

In recent years insect ravages have caused cotton crop losses estimated at upwards of $500 million a year in Asia, Africa and Europe. In Latin America these losses come to more than $140 million a year. In the U.S.A. the yearly loss is still some $250 million, while in a single year, 1950, boll-weevil depredations in the U.S.A. caused damage placed at $750 million.

With the coming of DDT it was thought for a time that these tremendous losses could be considerably reduced, but in a few years the insects had developed an immunity and its effectiveness was nothing like as good as originally hoped.

A recent development in insecticides, known as malathion, is now being widely used against boll-weevils and other pests of cotton with great effect. It is possible that, in time, the insects will develop an immunity to this chemical also, but it is hoped this will not be for several years.

Another new weapon is a systemic insecticide. Known as thimet, this chemical is coated on to the seed itself. When the seed sprouts thimet enters the sap system of the young cotton plant. Insects which chew or suck on the treated plant die with surprising rapidity for several weeks after the plant has come through the ground. Great caution, however, must be used in applying thimet, as it has a high degree of toxicity to man and animals.

The maker, American Cyanamid Co., U.S.A., recommends that the seed be treated with thimet in sealed drums or with special treating machinery, preferably under expert supervision.

Agricultural scientists believe that, at least for the present, combined usage of insecticides, such as malathion and thimet, to which insects still have not developed immunity, could conceivably increase the world cotton yield by 5 million bales or more.

A recent test case in the Brazilian state of São Paulo gave even greater hope for a temporary victory against the pests of cotton. Use of thimet on seed there resulted in an increased yield of 20%, while in a field nearby the insects devoured the crop.

A report from Union Carbide International Co. speaks of a new experimental insecticide which shows promise for control of many major cotton insects, including pink bollworm, bollworm and boll weevil. It is an aryl urethane and its chemical name is l-naphthyl N-methylcarbamate. Toxicology work in progress indicates that it should rank as one of the safer insecticides.

Two young cotton plants
(Left) *treated with thimet;* (right) *untreated*

Avoid Poisoning Bees

Bees are often killed by sprays and dusts used against pests and weeds. Fruit growers, farmers and others should, in their own interests, co-operate with bee-keepers in taking all possible precautions against poisoning bees when using these preparations on crops and orchards.

The British Ministry of Agriculture has appealed for greater co-operation and consultation between bee-keepers, farmers, fruit growers, market gardeners and spraying contractors.

The following precautions should be taken to avoid killing bees:

1. Don't use insecticidal sprays or dusts on open blossom in orchards or on seed crops in flower, especially rape, which should be sprayed before the blossom opens.

2. Carry out chemical weed control on cereal crops before the weeds reach the flowering stage. This applies particularly to charlock, whose flowers are very attractive to bees.

3. Never use arsenic in orchards except (*a*) before the flower buds open and (*b*) after complete petal fall. Arsenic is deadly to bees.

4. Clean cultivate or gang-mow orchards immediately before applying poisonous chemicals.

5. Avoid letting sprays and dusts drift on to hedgerow flowers or neighbouring fields where bees are foraging.

6. Take care not to dump waste chemicals or empty containers where they might contaminate ponds or other places likely to be used by bees for drinking.

7. Bee-keepers should be on the look-out for local crops likely to be treated and should approach the growers about the timing of pest control operations or obtain a warning of impending action.

NEW PUBLICATIONS

The Study of the Soil in the Field

By G. R. Clarke. 4th edition. Pp. 204, illustrated. Clarendon Press, Oxford: Oxford University Press. 1957. 35s.

The author of this book writes with unquestioned authority on a subject with which he has been closely associated for a great many years and on which he holds very decided and constructive ideas. He contends that to arrive at a rational utilisation of land the living soil in relation to its natural environment, rather than the desiccated specimens which find their way into the laboratory, must receive priority of study. To this end the report on the soil in the field should be so complete that no further information is required. The field report is based on the 'site and profile' principle, which is described in detail, as are also methods of soil sampling, soil survey, mapping and the use of air photography for soil survey purposes. The book concludes with a summary of the main points in some recognised systems of soil mapping and classification.

The book is written for both students and soil scientists. The former will find it invaluable; it will familiarise them with soil vocabulary and teach them the procedure of soil survey so that such work may be undertaken with real understanding of the implications of each feature recorded.

Previous editions have been widely used as a basis for official soil survey work and have played a notable role in the adoption of uniformity in presentation of data and precision of terms used in soil survey work. The new format of the book gives it a dignity it did not previously possess; its appearance now is that of a book rather than a field notebook. A new section, covering more than 30 pages, is devoted to the use of air photography for soil survey purposes and is suitably illustrated. In addition, much of the text has been rearranged, enlarged or further clarified and new information is interspersed throughout. The author has, however, made one retrograde step. In the previous edition appeared a list of some useful books on soils. Instead of enlarging this list by inclusion of the most modern and comprehensive literature on the subject, this feature is now omitted. This is a pity in a book widely used by students. However, this new edition of an important study is so far an advance on its predecessors that its continued value to scientists and students is assured.

It is no conceit of the author that he should conclude his book with the following quotation from John Ruskin's 'Sesame and Lilies', followed by his own observation thereon:

'Well, whatever bit of a wise man's work is honestly and benevolently done, that bit is his book, or his piece of art. It is mixed always with evil fragments well done, redundant, affected work. But if you read rightly, you may easily discover the true bits and those *are* the book'.

'If, therefore, the writer has contributed anything towards helping the natural philosopher to perceive, observe, and record what there is in the soil and its environment to be seen, this little work will have served its writer's purpose'.

D. H. GRIST

Magnesium

By Dr. A. Jacob, translated from the German by Dr. Norman Walker. Pp. 159, illustrated. London: Staples Press Ltd. 1958. 40s.

In the first decade after the introduction of mineral fertilisers the mistake was made of considering their use in terms of a single nutrient applied alone. Such applications were successful in cases where the nutrient in question was markedly deficient; when, after some time, the soil became exhausted of other nutrients the continued single application no longer gave the same response and more generally yields began to decline seriously.

A great advance was made when the practice of supplying plants with nitrogen, phosphorus and potash in the form of a so-called complete fertiliser was adopted. These three came to be considered the major plant nutrients, because they were used in rather large amounts, were usually deficient in the soil, or, if present, were in a non-available form. The remaining nutrients, which were required by the plant in smaller amounts only, were, it was assumed, present in the soil in sufficient amount. This we now know is frequently not correct.

Only recently has it been shown that it is necessary to look on other elements also as major nutrients, which need to be taken into consideration in any system of complete fertilising. Thus, the idea of including calcium among the major plant nutrients is now accepted, but, since many fertilisers contain calcium in an acceptable form, its importance has been overlooked. Similarly, there has been a tendency to regard magnesium as a minor plant nutrient. Dr. Jacob's monograph recognises for the first time the fact that magnesium, being the central atom of the chlorophyll molecule, may well be a limiting factor in crop production, even if the requirement of the other four major plant nutrients, nitrogen, phosphorus, potassium and calcium, has been fulfilled.

A brief, but adequate, section on the chemistry of magnesium is followed by a full discussion of its role in plant and animal physiology. Other sections deal with the symptoms of magnesium deficiency in a wide range of temperate and tropical crops, the magnesium content of soils, the methods of determination and the interactions of other elements. These last will be of special interest to soil chemists.

Of particular value to the agronomist are the sections covering the magnesium content of plants, the balance of magnesium in agricultural practice and the use of its compounds in manurial programmes.

An extraordinary omission is the absence of an index for such an exhaustive work, but this is to some extent counterbalanced by the list of references, which is the most comprehensive review of world literature on the subject ever published, containing no less than 487 references. There are, unfortunately, a number of printer's errors which have not been detected in the proof reading. Apart from this minor consideration, the book is to be strongly recommended.

F. C. COOKE

USDA Publications

Yearbooks of the U.S. Department of Agriculture, Washington, D.C., are available as follows: *Grass*, 1948, 892 pp., illus., $2.00; *Trees*, 1949, 944 pp., illus., $2.00; *Insects*, 1952, 952 pp., illus., $2.50; *Plant Diseases*, 1953, 992 pp., illus., $2.50; *Water*, 1955, 766 pp., illus., $2.00; and *Soil*, 1957, 806 pp., illus., $2.25. The last is a volume divided into eight sections:

principles, fertility, practices, soil care, moisture, systems, regions, and special uses, and is primarily concerned with the management of soil.

Even if the editorial preface did not draw comparison with the famous 1938 yearbook, 'Soils and Men', no one knowing this previous USDA effort could fail to make it. The truth is that 20 years have not put the earlier book in the shade, yet one cannot help feeling that 20 years should have done this. The aim of these annual yearbooks has possibly changed, with more accent upon reaching the ordinary farmer, less upon satisfying already well-informed agriculturists. Certain subjects have certainly now had fuller treatment, *e.g.* the trace elements, about which so much more is known. However, the older themes are generally given a briefer treatment, and to many an expectant reader this will be disappointing. No doubt cost requirements have had some say in this. The 1938 book had over 1,200 pages and it cost $1.75; the new one, at $2.25, is a third shorter. Another feature of comparative book economy is the double-column presentation of the 1957 book. One knows this has been the custom with recent USDA yearbooks, but it is surely a change of deterioration. The double-column system is objectionable to the reading eye in a book of this size and page width. It may seem churlish to make these criticisms, but the book could have been a great advance upon its 1938 parent; it represents something of a lost opportunity. However, none of these comments should imply that it is not a most useful book and particularly cheap at its price, whether in dollars, or dollars converted to other currencies. D. P. HOPKINS

University of California

The U.C. system of soil mixes, soil and plant treatments and handling operations for producing healthy container-grown plants in nurseries - the result of 16 years' research by the Department of Plant Pathology, is described in Manual 23. The methods have been tested in commercial nurseries, and not just in the laboratory. The aim is prevention of disease rather than cure, with consequent increased yields and reduced costs. U.C.-type soil mixes are basic to the system, which also has the advantage of being easy to mechanise.

This illustrated manual of 306 pp. presents not only a general plan of action which will be most useful to growers in California, but also background information on the scientific bases underlying practice of the system, which will enable growers in other areas to adapt the system to their own conditions.

Copies may be obtained from: Agricultural Publications, 22 Giannini Hall, University of California, Berkeley 4, California, U.S.A. Price $1.00. Also available, free, from the same address is Leaflet 89, which summarises the section of the manual on soil mixes.

*

OEEC Publications

Labour Management on the Farm deals with such problems as achieving balance between the labour supply and the size of the farm; improving seasonal labour distribution; finding easier, quicker and more economical ways of carrying out farm operations; developing work methods for using new tools, machines and buildings and furnishing information for use in designing them; reducing physical strain; and maintaining good labour relations. The publication is the result of a survey carried out in Europe and the U.S.A. and a seminar held subsequently at Wageningen, the Netherlands. Price 12*s.*, $2.00 or F. fr. 600.

Making and Feeding of Silage, being the report of a training course held in Zürich, Switzerland, in September 1955 and attended by representatives of 14 European countries. A summary of the results and discussions is included and the full text of the technical papers that were presented is given. Price 8*s.*, $1.50 or F. fr. 400.

Land Consolidation is a report of investigations into the possibility of simpler and cheaper methods for achieving the consolidation of scattered holdings in Europe into more economic farming units. Representatives from 14 European countries attended a seminar at Wiesbaden in 1955. Discussions covered the legal, administrative and financial aspects of the work as well as problems involved in land surveying, land improvement and road construction. The present report includes the recommendations adopted at the seminar, the technical papers presented, country reports and descriptions of selected practical examples of land consolidation work in Germany. Price 8*s.*, $1.25 or F. fr. 400.

Agricultural Policies in Europe and North America. This is a sequel to a previous report bearing the same title which was published in 1956. Part I of the present report gives a description, country by country, of the main characteristics of national policies for supporting agricultural prices and incomes. Part II gives a synthesis of the most important facts that emerge from the first part and examines the possibility of a closer co-ordination of national policies. Price 28*s.*, $4.50 or F. fr. 1,400.

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Oils and Oilseeds

The Annual Review for 1956, published by Frank Fehr & Co., states that during 1956 both world production and world consumption of oils and fats attained record levels. The most significant crop increases took place in the U.S.A. and the Argentine. Production was also well up in Canada, West Africa and the Philippines. 1957 marks the centenary of the company and a short history of the House of Fehr is included. There is also the usual wealth of statistical data and information on all oil-producing crops and commodities produced from oil.

*

South Pacific Commission

A paper of valuable practical application by E. J. E. Lefort entitled 'Weed-killing by Chemicals in Tropical Crops' has been published as Technical Paper No. 108. A guide to the selection of the most suitable weed-killer is given, as well as a complete classification and notes on general considerations.

Obtainable from the Commission, Noumea, New Caledonia, price 2*s.*

Bookshop Service

Books reviewed in WORLD CROPS and all other scientific or technical **books** may be obtained from:

Technical Books,
308 Euston Road,
London, N.W.1.
Telephone: Euston 5911.

Other miscellaneous publications reviewed should be obtained direct from the addresses given.

MACHINERY AND EQUIPMENT

Sputnik Rings

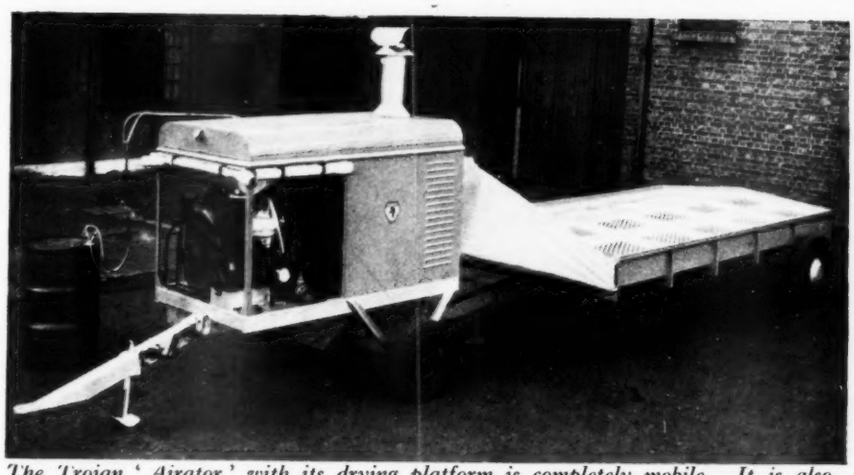
The latest invention by Packman Machinery Ltd. concerns the mechanical planting and fertilising of potatoes. Not only is the correct placement of the seed potatoes provided for, but also the correct placement of the accompanying fertiliser, and the main purpose of the invention is to save about one-third of the amount required without any reduction in crop.

Instead of broadcasting expensive fertiliser or sowing it in strips down the prepared potato valleys, the new Packman potato planter lays the fertiliser in satellite rings above each seed potato. The fertiliser does not come in contact with the seed, but forms a halo around each, and thus damage due to direct contact with concentrated salts is avoided.

The new machine provides for the seed to be accurately placed at a desired depth in the ground, then to be lightly covered with soil, following which the fertiliser halo is placed round and slightly above the seed. Finally, the following disks fill in the trench with soil. All these operations are, of course, going on continuously when the machine is drawn over the ground by the tractor. Neither the tractor wheels, nor the planter wheels, run over the land in which the potatoes are planted.

The underlying theory is that, when a seed potato commences to grow, the first shoots are formed from the nutriment contained in the tuber itself; then, as the rain washes the nutrients released in dilute solution from the fertiliser mixture downwards, the young plant is able to send its collecting roots outwards in all directions to obtain further nutriment. As the feeding root system of a potato is only about 6 in. in dia., it will be apparent that much of these expensive plant foods is wasted when fertiliser is broadcast or sown in bands or strips in the valleys between the lines of plants, as so much of the material is never reached by the root system.

The Packman potato planter, showing the fertiliser feed mechanism



The Trojan 'Airator' with its drying platform is completely mobile. It is also possible to have stationary drying platforms made of concrete and move the unit from place to place

Reader Service

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A Mobile Drying Unit

The Trojan 'Airator', a mobile drying unit, appears to meet a long-felt want for the drying or re-drying of tropical produce, such as copra, tapioca root (*gaplek*), cocoa and coffee beans, pepper, small fish and, above all, paddy, the staple food of the tropics. This machine is a neat assembly of engine, fan, combustion chamber and heat exchanger, mounted on a rigid 2-wheeled chassis, which can be drawn behind a tractor or jeep and so taken to the different drying depots in succession on agreed days, according to schedule.

At each depot there would be a sack platform with between 40 and 80 drying points or airholes, over which the bags could be placed. The hot-air machine is coupled by a large canvas hose to this platform, which is a hollow rectangular chamber, made of local bricks, reinforced concrete or pre-cast concrete blocks; hot air is blown in and passes uniformly up through each bag.

Economy results from the use of diesel fuel for both power and heat. The running cost can best be assessed from the maker's quotation that it takes 1½ gal. of fuel to remove 1 cwt. of moisture. This means theoretically that this amount of fuel will dry 2 cwt. of raw coconut meat.

There are also many uses of this most useful machine in agriculture in temperate climates, such as in-sack, in-bin or in-barn grain drying, grass drying for the production of high-quality feed, hop drying and the con-

The ' Stokold President ' light tractor for farmers, market gardeners and smallholders

ditioning of potatoes or root crops in clamps or stores.

A useful brochure, ' Crop Conditioning the Trojan Way ', which outlines the theory of crop drying and conditioning and describes the many applications of this machine in far greater detail than is possible in this short note, can be obtained through our Reader Service.

Lightness

The ' Stokold President ' air-cooled diesel tractor has been evolved to meet the needs of farmers and horticulturists who require a simple, cheap, yet efficient tractor, as much of the work on a farm is light work, for which a larger tractor is not necessary. At the same time this tractor will pull substantial loads on soft, heavy going without any trouble. It will pull two furrows under average conditions and the lightness reduces ' hard-panning ' of the soil. The pressure exerted on the ground surface by its tyres is actually less than that exerted by the average human being.

The advantage of this is obvious in such work as row-crop hoeing, low-volume spraying and gang-mowing, and operating costs are naturally less than for larger tractors doing the same work. The small dimensions, manoeuvrability and high clearance of this tractor also make it extremely suitable for work in paddy fields, both dry and flooded.

A range of specially designed implements has been produced for use with the tractor, but lift arm adaptations are available to make possible the attachment of any mounted implements of other makes or trailing implements which the user may already possess. The drawbar is of the universal adjustable type.

The four gears give three forward travelling speeds from 1.8 to 8.3 m.p.h. and one reverse at 2.9 m.p.h.

The heavy-duty air cleaner, fuel filter and lubricating oil filter, all with replaceable paper elements, and the total enclosure of all working parts, afford complete protection against dust.

The manufacturers are H. J. Stockton & Co. Ltd.

Versatility

A new light Fordson tractor, the ' Dexta ', made its first public appearance at Smithfield. This handy little tractor has been designed for conditions requiring less power and weight than its ' workmate ', the Fordson 'Major', which remains in production.

The machine weighs only 2,980 lb., which is 2,000 lb. less than the 'Major', and it develops 32 b.h.p. at 2,000 r.p.m., as compared with more than 40 b.h.p. at 1,600 r.p.m. for the larger machine.

The ' Dexta ' is completely new in design and embodies a 3-cylinder diesel engine, 6-speed constant-mesh gearbox and an optional ' live ' hydraulic system and ' live ' p.t.-o. This ' live ' system, it needs to be explained, is based on the use of a dual clutch, controlled by a 2-stage movement pedal—the first movement stops the tractor and the second the hydraulic pump and the p.t.-o. Otherwise expressed, when the tractor is stopped the attached implement can continue to operate, if so required.

Irrespective of whether or not the hydraulic system is ' live ', it provides for draught and position control of the implement. The method of selective depth control by implement draught enables work to be done under constantly changing soil conditions, and irrespective of soil resistance and ground contours, which normally involve loss of wheel grip.

The hydraulic system offers two methods of working, the choice being made by means of a selector lever. *Draught control* automatically ensures that the load remains constant irrespective of variations in the resistance of the soil; *position control* enables the implement to work at any given depth and this position is maintained irrespective of changes in soil resistance.

The six forward and two reverse speed gearbox provides a range of working speeds from below 1 m.p.h. up to 17 m.p.h. An optional extra is the fitting of power-adjusted rear wheels; the front and rear wheel tracks are adjustable in 4-in. steps from 48 in. to 76 in.

The new tractor is economical, manoeuvrable and handy, and on the larger farms it will be found to be a useful complement to the ' Major '; on smaller farms the complete range of implements, which have been specially designed to match the power of the tractor, makes it the complete power farming unit.

More Power

Offering many new features, including power steering, differential lock, disk brakes and a choice of category 1 or 2 hitches, the new Massey-Ferguson ' 65 ' tractor, retains all the proven features of the Massey-Ferguson ' 35 '. The transmission and back-end linkages are essentially the same for both tractors, so that an interchange of implements between the two will be possible, with

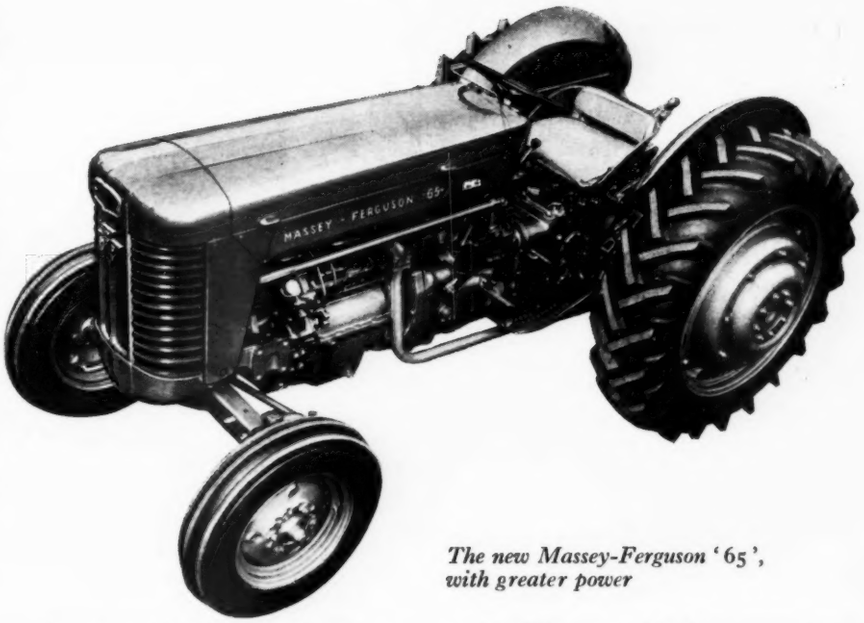
this proviso: the hydraulic mechanism of the '65' has a 30% greater power output and over 40% greater lift capacity than the '35'. This provides a lift of 1,800 lb. at the lower link ends, compared with 1,200 lb. on the '35'.

The new tractor is powered by a 4-cylinder diesel engine manufactured by F. Perkins Ltd., which develops 50.5 b.h.p. at 2,000 r.p.m. The manufacturers quote the following figures for fuel consumption: at 1,000 r.p.m., .38 pint per h.p./hour, and at 1,800 r.p.m., .41 pint per h.p./hour.

The new gearbox provides a speed for all conditions and to suit every job. The six forward gears allows a range of working speeds from 1 m.p.h. to 14 m.p.h., with a creep speed of ½ m.p.h. and two reverse speeds. The tractor is fitted with 'live' p.t.-o.

The extra power and lifting capacity necessitates powerful brakes. The double disk brakes are completely enclosed and thus protected from dirt, dust and water, so that there is no risk of fading. The two brake pedals are both operated by the right foot and can be operated together as a simple master brake, or can be applied independently to allow extra sharp turns to be made quickly and with ease.

The rear track is adjustable in 4-in. steps from 52 in. to 88 in. and the front wheels from 48 in. to 80 in. The wider settings are recommended only for light row-crop work or for work on steep slopes, so as to give added stability.



The new Massey-Ferguson '65', with greater power

Power steering is an optional extra which considerably reduces fatigue. Our representative had the opportunity of using the new tractor when it was drawing a 5-furrow plough working at 9 in. and can confirm the outstanding advantage of power-assisted steering. He was particularly impressed with the ease of control, the exact adhesion to the line of the furrow (even with hands removed) and the tremendous controlled power and ease of manoeuvre, which makes it a joy to drive.

Fertiliser Distribution

The Ardleigh Spraying Co. Ltd. are manufacturers of the 'Swift' fertiliser spreader, a machine which combines rapid filling, trouble-free operation, exact control of distribution and easy attachment to the 3-point tractor linkage.

A unique feature is the design of the feed in relation to the spinner plate. There is very little upward throw and it is unnecessary to fit any form of shroud to ensure satisfactory distribution. Extremely even distribution eliminates the possibility of double-spreading or overlapping in the line of movement of the tractor. The fan-shaped thrower effectively covers a width of 24 ft.

The machine can be mounted on the 3-point linkage in a few minutes. The fertiliser hopper can be lowered until the frame rests on the ground, making for easy filling, and its open construction ensures freedom from clogging. The capacity of the spreader is 7 cwt.

The overall height of the machine is 5 ft. It is 3 ft. 6 in. wide and weighs less than 2 cwt.

One man can top-dress over 100 acres per day. A single-lever, spring-loaded adjustable control allows the rate of spread to be varied between 2 lb. and 15 cwt. per acre.

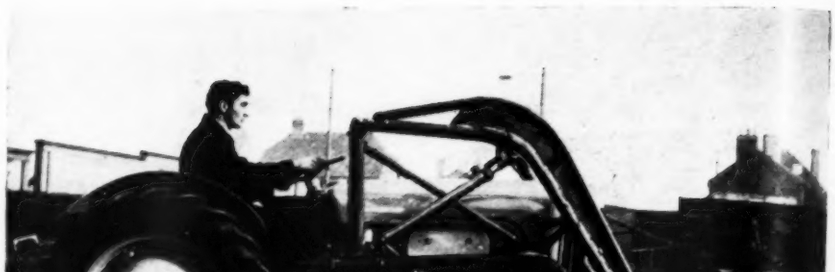
The Fordson 'Dexta' with F.R. (T.S.1014) deep digger plough

Mechanical Loading

Specially designed for the Massey-Ferguson range of tractors, the Model 'H35' is a one-man hydraulic loader with a lifting capacity of 10 cwt. It is suitable either for front or rear mounting and has a lifting height of 9 ft. 3 in. The actual implement fitted can be either a simple scoop, a manure fork,

a loading hook for sacks, a potato scoop, a buckrake, or a root crop bucket, according to requirements.

Using the manure fork, it is possible for one man to load an average of 11½ tons of manure from a farmyard in one hour; the angle of its tines can be altered by a simple adjustment. The whole assembly, including the powerful carrier arms, pillars, brackets and the hydraulic rams, can be fitted to the tractor in two hours. Midlands Industries Ltd. are the manufacturers.



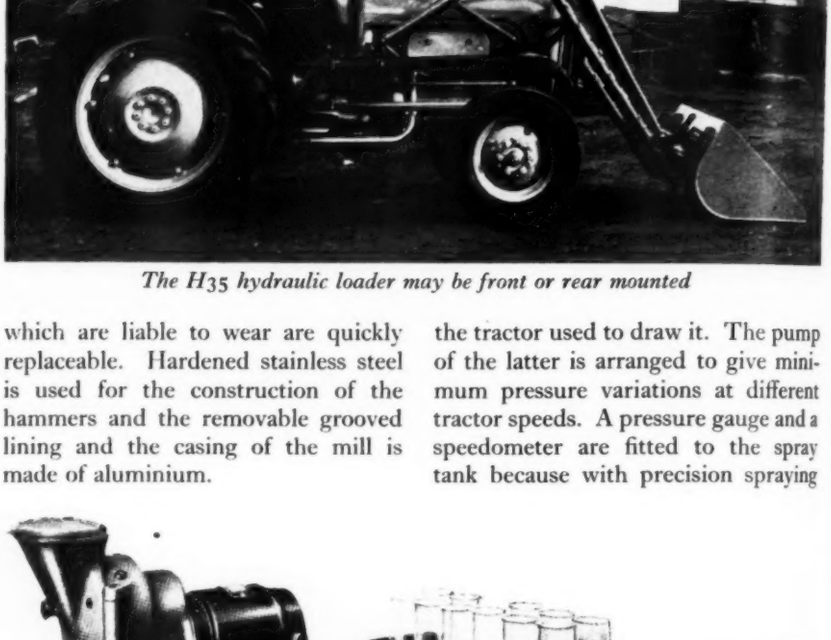
The H35 hydraulic loader may be front or rear mounted

A Laboratory Hammer Mill

A micro hammer mill, designed to reduce the particle size of small samples of soil or fertiliser, dried leaves or other parts of a plant, grain or dried fruit, coal, coke, peat or wood, and similar materials which break and do not contain too much oil or fat is an essential piece of laboratory equipment for the agricultural chemist.

With the Glen Creston C.580, samples are pounded to powder in 30 to 120 sec. by three freely swinging stainless steel hammers, the crushed particles passing through an interchangeable screen into a transparent plastic sample tube of 35 c.c. capacity. The standard outfit includes three interchangeable screens (1-, 1.5- and 2-mm. mesh dia.), a stand with 12 transparent plastic tubes and cleaning utensils. Extra fine screens of 0.7- and 0.5-mm. mesh dia. are available, if required. Motor speed is variable to suit the product.

There is practically no loss of material, as the hinged door of the small grinding chamber is sealed by rubber gaskets when closed, and the cover and the plastic tube fit tightly to the body of the mill. Cleaning is easy, the hinged door giving unhindered access into the interior of the mill. Any parts which are liable to wear are quickly replaceable. Hardened stainless steel is used for the construction of the hammers and the removable grooved lining and the casing of the mill is made of aluminium.



Micro hammer mill, with motor, interchangeable screens and sample tubes

A Versatile Boom Sprayer

A new sprayer – Chafer's 200 Q.F. – is a universal machine, which has been designed especially for large farmers and agricultural contractors. Two models are available – one having an engine-driven pump, the other which can be operated through the p.t.-o. of the tractor used to draw it. The pump of the latter is arranged to give minimum pressure variations at different tractor speeds. A pressure gauge and a speedometer are fitted to the spray tank because with precision spraying it is necessary to know at what speed the sprayer is moving.

The spray booms have a 32-ft. coverage, comprising one centre section and two side arms, which can be folded up into a vertical position for travel; the boom is adjustable in height from 18 in. to 53 in. The wheel track, too, is adjustable from 56 in. to 63 in., with a tank ground clearance greater than that of any ordinary row-crop tractor. The spray bar is fitted with anti-drip 'U'-type jets, which can be fitted with potato underleaf downpipes, if necessary.

The machine is fitted with a 200-gal. corrosion-resistant chemical tank, incorporating a special filling and overflow device which prevents frothing and loss of liquid before the tank is full and three filters are fitted to ensure trouble-free spraying. Both models are self-filling in under 5 min.

The Chafer 200 Q.F. boom sprayer, ready for attachment to the drawbar and the p.t.-o. of the tractor behind which it is drawn. The spray boom, which can be folded up vertically, has a 32 ft. coverage

Agricultural Chemicals

Protection of crops and stored products with fungicides, weedkillers and insecticides

Blemishes on Citrus

Research work now being carried out at the Citrus Experiment Station in Florida, U.S.A., is of importance to growers of grapefruit, oranges and tangerines wherever the control of russet and greasy spot in the groves is a problem. The conclusion they have reached is that zineb, marketed under the trade name of ' Dithane ', will give control, both more economically and probably more effectively, than the sulphur sprays which are at present the standard method of control.

Russet is an external blemish on the skin of the fruit that may appear after the fruit is well formed on the tree. When the injury is only a slight bronzing of the skin it is known as ' golden russet '; more serious damage, however, may cause a thickening of the skin, called ' black russet '.

Russeting, prevalent in nearly all citrus-growing areas in the U.S.A., can seriously reduce the profit, as it downgrades the fruit, both in quality and size, and in extreme cases may make the fruit unmarketable. Greasy spot until recently was only of minor importance, but it is now serious in some citrus areas. It produces a greasy blemish on the leaves and, when severe, will defoliate the trees.

For many years it was thought that both were caused by the citrus rust mite. Now it is considered that greasy spot is a fungus disease and it has not been established that the mite is the cause of russeting. The evidence is to the contrary.

On Duncan grapefruit zineb-treated trees yielded 99% russet-free fruit, while of the fruit from unsprayed trees, only 2% was russet-free and bright. Hamlin oranges showed no russeting at all on sprayed trees and 20% russeting on the unsprayed. Similar results were obtained with other varieties of citrus.

To control russeting adequately with sulphur, growers have to spray repeatedly throughout the summer and the cost both of labour and material is mounting. Control with ' Dithane ', manufactured by Rohm and Haas Co., is obtained with only a single application.

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A New Weedkiller

It is claimed that the control of cleavers, chickweed and other weeds in cereal crops should be much easier with the introduction of a new weedkiller known as ' Proponex '. This product is being introduced by Shell Chemical Co. for the coming season, following extensive field trials.

Hitherto control of these weeds was achieved by using DNOC, or sulphuric acid, which required special equipment and protective clothing. It is non-poisonous and only the precautions normally taken with hormone weedkillers are necessary.

The new product is safe and easy to handle, requires no special equipment and can be applied through low-volume spraying machinery.

' Proponex ' will also deal with a wide range of common weeds, including charlock, bindweed, curled dock, fat hen, knotgrass, creeping thistle, runch, persicaria and many others.

' Proponex ' is recommended by the manufacturers for application after cereals have reached the two-leaf stage, but before ear emergence, and cleavers should preferably be between 2 in. and 3 in. high. The standard application is 6 pints in 20–30 gal. of water per acre.

*

Contact Insecticides

' Didimac 25 ' is a formulation mainly intended for the control of insect pests in ground crops, but it can also be used on fruit, coffee, cotton, cacao and other crops. It is claimed to be effective against leaf hoppers, leaf beetles, vegetable bugs, caterpillars and thrips. It is recommended for the control of capsids on cacao; thrips, whitefly, bollworm and the lygus bug on cotton; and the antestia bug and thrips on coffee.

The product has been developed by Plant Protection Ltd. with the object of providing a liquid DDT formulation as a more suitable and satisfactory

A crop of untreated barley being dragged down by cleavers, Galium aparine

alternative to the dispersible powders used in water-based sprays.

It can be applied either in high or low volume and is easily measured and mixed. The spray droplets readily coalesce on the leaf surface and so give excellent coverage, a thin film of DDT being left on the leaf surface as the solvent evaporates. It is a good contact insecticide, which acts quickly on the insect's waxy cuticle and so gives a rapid kill.

*

A Selective Weedkiller

'Tropotox', a May & Baker product, is a brand of stable, aqueous solution containing (4 - chloro - 2 - methylphenoxy) butyric acid – 40% active acid equivalent (4 lb./gal.) in the form of its sodium salt. It was the first product based on MCPB to become commercially available, being introduced in 1954. It is non-inflammable and non-corrosive and, under normal conditions of use, presents no undue hazard to the health of spray operators, livestock or game.

The outstanding value of 'Tropotox' is that, although toxic to a wide range of weeds, it is harmless to young clovers, cereals and certain varieties of peas. This is due to the fact that MCPB, while having no weedkilling properties itself, is converted by many weed species into MCPA within the weeds themselves. Cereals, clovers and certain other leguminous plants do not have the power to carry out this conversion and are therefore unharmed.

This conversion of MCPB to MCPA by weeds can only be accomplished when the weeds are making active growth: with annuals this is at its maximum in the early seedling stage and with most perennials when the flowering spike has begun to run.

Adverse weather conditions, in particular low temperatures and drought, slow down plant growth to a minimum and reduce considerably the weeds' capacity to carry out the conversion. The aim should be, therefore, to time application as far as possible during warm, good growing conditions when weeds are making rapid growth. Good coverage of weed leaves also seems to be essential and in this connection volume rates of 15 to 25 gal. per acre are preferable to 10 gal. or less per acre.

The weeds affected by MCPB are, with few exceptions, those which are affected by MCPA, but with individual differences in relative susceptibility. Creeping thistle, annual nettle and knotgrass are in practice just as susceptible to MCPB as to MCPA. Fat hen, common orache, poppy, hemp-nettle and others have been equally well controlled if sprayed at the younger stages of growth, although the speed of action may be slower. In general, weeds which are resistant to MCPA, such as mayweed, corn marigold and cleavers, are also resistant to 'Tropotox', but one exception to this rule is the small annual nettle, which, while somewhat resistant to MCPA, is well controlled in the earlier stages of growth by 'Tropotox'.

*

Protecting Stored Potatoes

Losses of ware potatoes from dry rot and sprouting can easily reach 20% of the total in late stored crops. 'Fusarex' gives safe and effective control against both dry rot and premature sprouting.

A single application of this dust at the rate of 10 lb. per acre is all that is needed and keeps potatoes sound and sprout-free until well into the following spring. Sound potatoes required for manufacture and feed during the summer may be treated in the spring, removing any existing shoots before treating. Correctly stored, the tubers will then remain good until mid-July.

For seed potatoes the treatment is carried out at lifting and this gives protection during the period of storage. Treatment will not affect germination on planting provided the instructions for storage and airing are followed.

'Fusarex' is a product of Bayer Agriculture Ltd.

*

Ultra-low-volume Spray Chemicals

The successful introduction of ultra-low-volume application of pesticides to many crops has been achieved, mechanically, by such equipment as Micron, Micronette, Motoblo etc., and recently by aerial spraying equipment.

This has necessitated the development of special highly concentrated ready-for-use materials for use in dilution with non-phytotoxic oils. In England the Standardised Disinfectants Co. has specialised in this field for some time and in France great advances have also been made by Schloesing Frères, of Marseilles, whose products are widely used in France and French possessions overseas.

The Standardised Disinfectants Co. and Schloesing Frères have now concluded an agreement whereby the latter's range of 'Schlofog' will be manufactured in the U.K. and made available for Commonwealth markets.

*

Winter Washes

Is it possible to control orchard pests by spring and summer sprays alone? Can we be sure of good spraying weather next spring just at the time when the young aphids and apple suckers are most vulnerable? Can we expect to kill them all with one or two applications during the hatching period? And what about the bryobia mite? Is it sufficient to try to control it with summer sprays alone?

These are questions posed by the Murphy Chemical Co. Ltd. in recommending the application of 'Mortegg' tar oil on a fine winter's day when labour is available, when there are no leaves on the trees and we can be sure of hitting every aphid and sucker egg.

Tar oil is available in two forms – a black free-flowing wash, which can be used with most waters; for very hard and saline waters 'Mortegg' emulsion is recommended by the manufacturers, who claim that it is specially suited to the difficult waters of the Wisbech district in East Anglia.

*

More Hops, More Beer

The presence of 'downy mildew' on hop vines can make all the difference between a good and a bad season for the grower. Caused by a parasitic organism, *Pseudoperonospora humuli*, its control by fungicides is not entirely satisfactory because they are not sufficiently absorbed to reach internal infection.

As a result of research carried out at Oregon State College and at Stanford University, California, it is claimed that the disease has been successfully controlled in the U.S.A. with a new antibiotic, known as 'Agri-mycin 100' – a combination of streptomycin and oxytetracycline – applied as a spray.

In actual field tests 85% control was obtained by two applications; the first after crown pruning, but before vine training, the second a few days after the first vine training. The early spring, when the infected shoots first appear, is regarded as the best time for treatment.

WORLD CROP REPORTS

INTERNATIONAL REPORT

Sugar-beet

World sugar-beet production in 1957 is forecast at 129.7 million short tons. This would be a record crop, exceeding the previous record of 124.8 million tons in 1956 and the pre-war average of 82.1 million beets by 58%. The increase is due to larger planted acreage and good yields in most countries, with the notable exception of the U.S.S.R. and the U.K.

Beet production in *North America* is expected to increase from 13.9 million tons in 1956 to 16 million tons in 1957, due partly to an increase in acreage of 11.2%. Production in the U.S.A. will probably increase by 15% over the 1956 production and 56% over the 1935–39 period, with harvested acreage increases of 11.7 and 6% respectively. Canada will increase her beet production by 5,000 tons above the 1956 beet estimate if anticipated yields materialise. The acreage increase is 5,000 acres.

The 1957 total beet acreage in *Europe* (excluding U.S.S.R., see below) is 6.5 million, compared to 6.7 million in 1956 and 4.2 million in 1935–39. The forecast of beet production in 1957 is 77.4 million tons, an increase of 4.9 million over 1956, despite the decrease in acreage, but only one million tons larger than the 1955 crop, which was then a record crop. The 1957 average yield per acre is expected to be 11.97 tons, compared to 10.9 in 1956, 11.5 in 1955 and 12.2 in the 1935–39 period. This increase is due to good growing conditions in most of Europe, especially in Belgium, East and West Germany, Ireland, Netherlands, Sweden and Poland. U.K. production dropped by 638,000 tons, although acreage was about the same as last year.

The acreage in the Netherlands was reduced as a result of the low yield in 1956 and the increasing production costs, although the farmers are receiving higher prices for their beets than in previous years. However, favourable weather conditions have increased the yield per acre. In 1956 it was 16.3 and in 1957 it is expected to be 20.1, resulting in total beet production of 3.2 million tons.

Beet production in the *U.S.S.R.* is forecast at 32 million tons from 5 million acres, while the 1956 crop was 35 million tons from about the same acreage.

Increases in acreage with forecasts of increases in production are indicated for most other countries. Both *Israel* and *Chile* are increasing their acreage and production. In the near future they will be producing enough sugar to enable them to make substantial reductions in imports.

REGIONAL REPORTS

Europe

The crop of dessert and cooking *apples* in the OEEC member countries as a whole in the present season shows a very sharp fall compared with previous post-war years. The explanation is in the first instance the adverse weather conditions in the spring of 1957 and, in addition, the fact that the present season is an ' off-year '. Because of the effects of the severe cold spell it has been necessary to destroy trees in certain areas, especially in Germany. The quality of the fruit is, in general, good.

Production for the area as a whole will probably fall by some 40 to 50% as compared with 1956–57, when production reached the record level of 6 million tons, or by some 25% as compared with 1955–56, the previous ' off-year '.

It is in France, Germany, the Netherlands and Switzerland that production has been the most severely affected; the crops of the three first-mentioned countries are expected to reach one-third only of their level in 1956–57; the Swiss crop will probably not even attain one-sixth of that level. An important decline is expected also in Italy. Production will probably show a noticeable fall also in the other countries, except Greece and Portugal. In the Scandinavian countries, where the crop alternation is very marked, the crops are expected to reach the same level as in 1955–56 (a poor crop year) or, as regards Denmark, slightly higher.

Adverse weather conditions in the spring of 1957 gave rise to a considerable decrease in the *pear* crop, which will probably be one-third smaller for the area of the member countries than in the previous season, when it reached about 1.5 million tons. All member countries, except Switzerland and Greece, were affected. The most important reductions in the crop occurred in Germany, Belgium, the Netherlands and France. There were also substantial reductions in Sweden, the U.K. and Portugal.

China

Information about the 1957 harvest in China released by the Ministry of Agriculture forecasts that yields of *winter wheat*, despite drought at sowing and low spring temperatures, will show an improvement on 1956, although falling short of the production target. The figures given are on the basis that 370 million mow (one mow = 0.165 acre) will show an increased yield of 700 million catties (one catty = 1.102 lb.) over last year's poor crop. It is claimed that an increased output of *rice* over 1956 should be possible in most places. *Rapeseed* crops are said to be particularly good, showing an increase in production of 20% for the whole country.

U.S.S.R.

The 1957 *grain* harvest in Russia is expected to fall substantially short of the record crop in 1956. Adverse weather conditions in Kazakhstan, which region contributed one-third of the total harvest last year, have reduced the crop considerably. In an effort to save further losses during harvesting, 85,000 combine-harvesters manned by 450,000 skilled mechanics were sent to the region, many from distant parts of the country. The uncertainty of the climate in Kazakhstan has now led to a drive to open up new land in Siberia, which is considered to be far less subject to drought. Work is to be put in hand to open up another 30 to 35 million acres of former virgin land. *Sugar-beet* and *potatoes* are also to be grown extensively in the newly cultivated regions of Siberia.

Venezuela

Heavy rains and disease, combined with earlier cut-backs in planting due to a surplus, have so reduced the *rice* crop that, despite reserves, a deficit of at least 10,000 metric tons, which will

have to be covered by imports, is anticipated. Consumption last year was 30,000 tons. Two years ago the rice planting programme of the Venezuelan Development Corporation, which has since considerably reduced its activities in this field, led to heavy excess production.

Heavy rains have delayed the start of the grinding season and the 1957–58 *sugar* crop is expected to be less than the previous one of 195,000 tons.

The current *sesame* crop is estimated to be 14,000 metric tons below domestic requirements and oil-seed crushers have been authorised to import this quantity.

It is estimated that the 1957–58 *coffee* crop will be 30% below 1956–57; a prolonged dry season followed by too much rain is given as the cause. On the other hand, the *cacao* crop is expected to be normal at 16–17,000 tons.

Panama

The *rice* and *maize* crops were adversely affected by the long dry season and the poor rains which followed in July. The rice crop was further reduced by disease and was insufficient to meet demand. The Government has therefore been obliged to import 10,000 quintals of rice from Ecuador and 15,000 quintals of maize. It is feared that the *sugar* plantations have also suffered from the drought. The *coffee* crop, too, was lower this year and 8,000 quintals have had to be imported. It is expected, however, that next year's crop will be sufficient to meet local demand. There are some 20.6 million coffee trees in Panama, of which about 14 million are producing. *Tobacco* production also fell again slightly in the year 1956–57, 7,000 quintals being produced from 410 ha.

Experimental resowing of the *banana* plantations has been started on the Atlantic side in an area which had previously been abandoned on account of Panama disease. Helicopters will be used to spray the plantations with insecticide, but there is no great optimism that the disease has been conquered.

Union of South Africa

The Union exported 6.4 million cases of deciduous and sub-tropical *fruit* in the last export year. The biggest quantities exported were grapes (4.3 million cases) and apples (1.7 million cases – a record). Pear exports were slightly reduced. The quantity of dried fruit exported was more than 4.5 million lb., of which 2.1 million lb. were raisins, 750,000 lb. apricots and 500,000 lb. sultanas.

It is estimated that the Sundays River Valley exported about 1.3 million cases of *citrus* in 1957 – worth about £3 million. The crop was about 10% bigger than last year, when South Africa exported a record crop of nearly 6,750,000 cases, which sold for nearly £14 million.

It is expected that between 15,000 and 20,000 tons of *lucerne* will be available for export this year; total lucerne production in the Union is estimated at 300,000 tons.

The 1956–57 crop of *tobacco* amounted to 830,000 lb., and it was hoped to sell the bulk of it locally.

Zanzibar

Pemba, the island north of Zanzibar which is included in the domains of the Sultanate, is harvesting the largest single crop of cloves the world has ever known. Owing to ideal weather conditions, the maturing of new planting schemes and a recession of 'sudden death' and 'dieback' to clove trees, the 1957–58 season is expected to end with a total of approximately 21,000 tons. Seventy thousand African pickers were employed.

Uganda

The worst drought for 50 years has destroyed all hopes that the coming season's crops of *cotton* and *coffee* would be record ones. Originally it had been estimated that the cotton crop might reach as much as 450,000 bales and the coffee crop 65,000 tons. Now it is thought that the cotton crop may prove to be less than 300,000 and the coffee crop nearer 45,000 than 65,000 tons.

Cyprus

The condition of most *citrus* groves is good and fruit development has been satisfactory. Yield prospects appear reasonably good and a satisfactory crop is forecast for the 1957 season.

Picking of *cotton* has been completed, but yields are estimated to be only fair.

Development of *groundnuts* has been satisfactory and yield prospects are good.

The harvesting of *hemp* has been completed and yields are reported to be about average.

The condition of the *olive* trees is satisfactory and the development of the fruit is, in general, considered to be reasonably good, especially after the heavy rains, which helped a great deal. Production varies considerably from district to district according to the severity of the summer's drought. In some areas, which were not so short of irrigation waters, yields are thought to be as much as 30% up on last year, while in others the production will be on a considerably decreased scale.

The growth and development of the winter crop *potatoes* are satisfactory and control measures have been taken against late blight.

The gathering of the *tobacco* crop has been completed and production is estimated to be approximately 7,500 tons of yellow leaf tobacco. More farmers are now employing improved methods for drying the leaves.

England and Wales

Good progress was made with cultivations and sowing, and in general field work is well forward. Autumn-sown crops are generally strong and healthy. The lifting of potatoes is virtually complete; the effect of blight does not appear to be serious except in some coloured varieties, but the yield per acre is below average. Good progress was made with the harvesting of sugar-beet and other root crops. Pastures continued to provide keep and stocks of winter keep were not drawn on to any appreciable extent.

Conditions were generally favourable for sowing corn, especially during the second half of the month and, on the whole, satisfactory seed beds were obtained. Wheat has germinated well and early-sown crops are well forward; slug damage, severe in some cases, is reported from many districts. The small area of *barley* sown has germinated well and made good progress, but some slug damage is reported. *Oats* are healthy and vigorous. *Rye* has made good growth and looks well. *Beans* germinated well and have made good growth.

Acknowledgment is made to *For. Crops & Mark.* and to *Spec. Reg. Inform. Services* for much of the information contained in the above reports.

The item on England and Wales is abstracted from the monthly report of the Ministry of Agriculture, Fisheries and Food on agricultural conditions as at 1 December.

Editorial Comment

Stars of the show

EXHIBITORS at the CROP PROTECTION AND PEST CONTROL EXHIBITION to be held at the Royal Horticultural Society's New Hall from 12–15 May are expecting to reap a rich harvest of overseas orders, as the response from overseas buyers who have been sent preliminary invitations has exceeded all expectations.

No less than 59 overseas governments have so far indicated their intention of sending representatives to the Exhibition, and it is already known that farmers, planters, growers, importers and buying agents from more than 106 countries will be attending.

The Exhibition is also bound to attract hosts of British farmers and keen gardeners, as well as trade representatives, so that manufacturers who cater mainly for the home trade will not be disappointed. It is also expected that many factory and flour mill managers will want to learn about the latest products for rodent and industrial pest control.

Certain exhibits will be of a mainly scientific interest, so that the show will have something of interest for the applied biologist and agricultural scientist as well as for merchants and large-scale users of pesticides and herbicides.

From the exhibitors' point of view, the essential value of the Exhibition will be that it provides the opportunity to ' project ' the subject of pest control to the trade and to the public (and overseas buyers) for the first time as a separate entity. In ordinary agricultural and horticultural shows, the ' live ' exhibits – the flowers, produce or livestock – steal the show, and attention is focused on them almost to the exclusion of less spectacular items such as insecticides, sprayers, and farm machinery.

At the New Horticultural Hall the subject of crop protection, pest control chemicals, spraying machinery and appliances will be the ' stars ' of the show, and any plants or animals will be present only in a supporting role. It will be interesting to see how the public reacts to this inversion of the usual state of affairs.

A new winter wheat

WHEATS OF the world can be divided broadly into two classes – winter and spring wheats – the difference being mainly one of reaction to temperature. Winter wheats require a period of low temperature before the plant will run to head. Spring wheats will run to head largely irrespective of temperature and do not require cold stimulus before flowering can be initiated.

The release of a new wheat named ' Winglen ' by the New South Wales Department of Agriculture as the first Australian-bred winter wheat, marks an important milestone in Australian wheat breeding. Winter wheats as a class are quite unfamiliar to many Australian wheat growers.

Most major wheat-producing countries of the world generally grow both winter and spring types, depending largely on the climate of the particular area. In colder regions winter wheats are generally favoured, and are sown in autumn, over-wintering in a semi-dormant vegetative state until temperatures rise sufficiently to break the winter dormancy. In Australia spring wheats have been grown almost exclusively but they are sown ' out of season ', that is in the autumn instead of the spring. By sowing in the autumn the plant makes its vegetative growth throughout the winter, which, in most parts of Australia is not sufficiently severe for either killing or inducement of full dormancy.

With increasing temperatures in spring, the plant flowers and is able to mature seed before extreme summer temperatures can affect it. One of the problems of early Australian growers was that all imported varieties, many of them winter wheats from Europe and England, were too late maturing. Now, with the breeding of the new winter wheat, many of the problems of the past will probably be solved.

The cost of mice

SOUND ESTIMATES of the grain losses caused by pests are difficult to obtain. Recent Scottish investigations on the losses caused by mice to stacked grain (*Scottish Agriculture*, 1957, **37**, 18) show conclusively that stack protection is worth while.

Here, for example, are figures for mice caught in protected and unprotected stacks:

Farm	*Protected*	*Unprotected*
A	Nil	57
B	45	350
C	1	80
D	38	380

However, this is evidence only of liability to loss.

On taking the corn out of the stack, after eight months' storage, the grain yield per 100 sheaves was measured and the following figures for actual loss of grain caused by mice infestation were established:

Farm	*Protected* lb.	*Unprotected* lb.	*Loss* lb.	%
A ..	493	457	36	7
B ..	296	191	105	35

In the case of farm B, when the stacking period was extended to 15 months, only 105 lb. of corn were

obtained from 100 unprotected sheaves, i.e., there was a total loss of 64%.

A mouse will eat one ounce of grain per week, so a population of 350 mice around a stack will consume several cwt. of grain in the period of seven or eight months between stacking and threshing. This, however, is not all the damage done. The grain becomes contaminated with excreta and chewed grain fragments (frass); there is also some risk of damage to the stack's construction. These secondary troubles could increase the time and cost of threshing as well as reduce the quality of the grain.

Protection of stacks is not difficult. The usual method is to raise the stack's base above the ground, either by building a number of pedestals or by means of a single platform. Pedestals can be cast in concrete, with beams to span them; a platform can be made by enclosing the stack space with a 6-in. thick, 2½-ft. high, concrete wall, filling the interior with rubble and concreting this over so that this ' floor ' projects outwards above the wall by about 9 in. Such a platform cannot be climbed by either mice or rats. The pedestal method costs about £12 per stack, the platform about £25, labour costs in each case being additional.

A conservative estimate from these studies is that the grain loss due to rats and mice is 1% for each month of stacking. This is equivalent to 4 cwt. of grain from a 5-ton stack for eight months pre-threshing storage. At minimum prices today, this represents a loss of £4 13s. Thus, platform protection can be regarded as beginning to pay for itself in five years, but these platforms will last for many years. On one Scottish farm, six platforms required no expenditure for repairs or maintenance in 20 years.

Tropical products research

THE FIRST major removal from the Imperial Institute building in London to make way for its demolition has been completed. The Colonial Products Laboratory has moved to new premises in Gray's Inn Road, and, in so doing, has brought to an end the working life of the old laboratories, which were built in the reign of Queen Victoria and which, for over 60 years, were devoted to the service of the British Empire. The name of the organisation is being changed to the Tropical Products Institute in anticipation of its function broadening again to that of assisting and advising territories in tropical and sub-tropical regions which are no longer colonies – those countries which have recently acquired independence within the Commonwealth being particularly in mind. The Institute will, of course, continue its work on behalf of the remaining British colonial territories – tropical, sub-tropical and temperate.

The new premises, which will accommodate the Tropical Products Institute, was erected in 1955 on a bombed site. There will be eight laboratories, devoted to advisory and investigational work on the plant and animal products of the tropics, a well-equipped papermaking laboratory and six other laboratories which will carry out fundamental research; another six laboratories will provide supporting facilities, such as the physical chemistry suite, the chromatography laboratories, the sample grinding room stores, and so on. There will also be a pilot plant laboratory and a workshop.

These laboratories together contain a quarter of a mile of benches which will provide good average working space for the 75 laboratory workers that the Institute will have on its staff when it reaches full complement of 150 scientific and administrative officers. Some bench space will be devoted to training overseas students and to other visiting workers. All the laboratories are equipped with modern fittings, ventilation and lighting.

The Institute possesses an extensive library which constitutes a unique collection of technical and commercial information on tropical plant and animal products, and of the agriculture and production of the British Commonwealth. This library will be open to the public for reference purposes on Mondays to Fridays between 10 a.m. and 5 p.m. The building also houses a museum and a conference room, which is to be used for lectures and for showing films.

Humpty Doo

DURING THE past quarter of a century, Australia's rice requirements have been met from about 35,000 acres in and around the Murrumbidgee Irrigation Area of New South Wales, where rice yields are the highest in the world.

Chief interest now centres on the Darwin-Katherine area of the Northern Territory where the experimental work carried out at Humpty Doo has resulted in the launching of what has been described as one of the boldest experiments in large-scale land development in Australia, see WORLD CROPS, **9**, 1957, 107.

The plan for the reclamation and settlement of some 750,000 acres in the Humpty Doo project, mainly for rice production, is based on an agreement between the Commonwealth Government of Australia and an American-Australian company, Territory Rice Ltd., giving concessions to the latter over the sub-coastal plain areas along the Adelaide, Mary, Wildman, and the West, South and East Alligator Rivers of the Northern Territory. On this flat, almost treeless and uninhabited land it is proposed to rely on the normal rainfall and seasonal flooding for mechanised rice production on an immense scale. The rate of development requires the company to take up and develop a minimum of 30,000 acres in the first five years, 130,000 acres within ten years and 280,000 acres within the first fifteen years. Once the

initial development of an area has been completed, at least half of it will be sub-divided and sold to individual farmers or worked on a share-farming arrangement. It is understood that the size of these individual holdings will be 500 acres each.

Experimental operations commenced in 1954; in the second year 290 acres were sown with a number of paddy varieties. Despite a flood which covered part of the crop with six feet of water, yields are stated to have been satisfactory. It is hoped to start large-scale production next year.

We would be the last to throw cold water on a project of such vision, one which may confer such immense benefits on Australia and at the same time provide a valuable contribution to Asian rice supplies. One cannot, however, be oblivious to the many unsolved problems concerning paddy cultivation in this area. To anticipate the solution of the many problems relating to land development is to court disaster and one would rather see a slowing down of the rate of development than that the scheme be endangered by precipitate development.

Sequel

SINCE WRITING the above editorial, information has been received from Australia that the scheme to develop 30,000 acres in the next three or four years has been severely pruned. Officials of the Company admit now that it was a mistake to try to expand too quickly and before the unpredictable water behaviour was known. There still remains the question as to what are the most suitable strains of paddy for the various environments to be found in this difficult region.

If, however, the scheme is ultimately successful, Australia will have surplus rice to export to neighbouring countries and will thus be able to make a material contribution to the economic stability of S.E. Asia.

Theft from warehouses

THE MERIT of the jute sack in handling farm produce or farm materials is that it can be used over and over again. Nevertheless, it can be a source of infection or infestation for susceptible products unless this problem is guarded against. In the recent Pest Infestation Research Report, one of the major problems dealt with in British colonial advisory work is stated as follows: 'Second-hand sacks are a serious source of insect infestation and more attention is being paid by Colonial Government departments to adopting methods for disinfecting second-hand sacks before they are used again'. For larger stores for farm produce – *e.g.* copra, cocoa, groundnuts – plans for sack fumigation units have been drawn up in the hope of encouraging more of these installations.

But the problem is still far from its final solution. In Africa one of the world's worst store pests, the *Trogoderma franarium* beetle, is at present spreading widely beyond the areas to which it has formerly been mainly confined and it is becoming a serious threat to maize, wherever maize is grown. Indeed, pest attacks on stored food are on the rise, rather than on the decline, in much of the agricultural world, possibly because native populations are enjoying higher nutritional standards and more food is being handled.

Besides fumigation, there is the possibility of using paper-lined jute sacks. Cocoa storage research has shown that paper-lined sacks give better protection against the entry of insects and also keep the produce in drier condition.

The language barrier

IT IS good news that the Chinese Government has accepted the Roman alphabet as a future basis for the Chinese language and that these letters will replace the complicated system of ideographs; it is further intended that all Chinese will adopt one dialect – that spoken in the north and generally known as Mandarin. According to an article in the Annual Report of the British Council, English is now to be taught in the junior schools in China, so far as teachers are available.

Equally important, we learn that English has superseded German as the second language in Russian schools, according to Eleanor Cave (*Daily Telegraph*, 11 December, 1957).

The proposal of Mr. Patrick Gordon Walker, M.P., that technical aid under the Colombo Plan should include the teaching of English and that a Commonwealth trust should be set up to arrange for the exchange of teachers (*Sunday Times*, 8 December, 1957) was warmly appreciated by the delegates to the Commonwealth Parliamentary Conference meeting in New Delhi, India, recently. Without English, he pointed out, India could not communicate with Ghana, nor Ceylon with Nigeria, with the ease they do today. In recent public statements, the Prime Minister of India pointed out that English provided the link between people speaking 200 different languages in India, and also a link with the outside world. Today advances in science, technology and other spheres of thought are so rapid that by the time books are translated into the different languages they are already out of date. Knowledge of a common language for international communication was therefore essential, especially for scientists, and why, asked Mr. Nehru, should it not be English?

At the Bandung conference in 1955, English was adopted as the official working language.

Speaking in London recently on the subject of the challenge of education, Miss F. W. Gwilliam, O.B.E., an expert on the subject of overseas education, said that it was most important that education in a second language should commence early – at the age of seven. She further pointed out that even if all the funds, teachers and facilities were available it will take more than 10 years for people in backward countries to begin to catch up, because they were mostly starting

from scratch. Obviously, it will take a child ten years to grow from the age of seven to seventeen.

Nevertheless, in scientific circles we persist in treating three languages, French, German and English, as the official languages and no real attempt is being made to begin to consider a common world language, even as a long-term policy. It is claimed, quite wrongly, that all trained scientists can converse in these three languages, but our experience, both at Hamburg and at Heidelberg, was that this was not true; the almost entire absence of Asian and African delegates was most marked and this is a matter for serious concern, for it is little use giving people self-government if it means that they are unable to participate effectively in international scientific, agricultural and other conferences and participate in overseas training. We felt the position of delegates from overseas and could fully appreciate their feelings. It is natural for them to be shy, but their inability to take in what is being said when French or German is being spoken will ultimately lead to their non-participation in such conferences.

Finally, there is another aspect to the question. It is only right and proper that anyone should be able to speak a second or even a third language in addition to his mother tongue – it is the hall-mark of the educated man. It is to be remembered, however, that science is making such increasingly heavy demands in the field of education that it is too much for a student of science to maintain his skill in two other languages, while trying to keep abreast of the vast amount of literature being published in his own language.

We do not advocate the use of English because this journal is published in the English language. It is simply that this appears to be the most practical, if not the only, solution. A precedent, if one were needed, is to be found in the fact that in mediaeval times Latin was adopted as the common language for Europe.

There is now no question of prestige. There can no longer be any suggestion of forcing English on people as an act of imperial policy. English is now more widely used than ever before and, according to the 1955–56 Annual Report of the British Council, well over half of the literate population of the world speak English as a first or second language. It is increasingly the international language of science and technology. In recent years about half of the world's scientific literature is in English and today English is undoubtedly the language of opportunity.

English will not establish itself as a world language without positive encouragement and as a deliberate act of policy. It is here that the United Nations and the British Council can give a lead not only in the field of technology and science, but also in social relations, so that we may move on towards a better understanding between nations and the realisation that we now live in one world – a world that was broken up and dispersed at Babel.

The temple of peace

THE TWELFTH regular session of the United Nations General Assembly, which after, unusually, completing its agenda on time closed shortly before Christmas, was generally described as rather dull, and did not call forth many press headlines. In perspective, however, its importance is manifest.

One may be enthusiastic about the UN and see it as, at least potentially, the temple of Peace and the healing of the nations. Or one may be made cynical by the lamentable amount of hypocrisy and unconstructive talk that is indulged in at Lake Success. More important, however, than either of these views or the many arguments which support each; and more important, too, than any successes or failures of this session, is the fact that *the UN continues to exist, and by doing so is beginning to acquire the solidness of a permanent institution.* Its usefulness as lightning conductor, sounding-board and forum would be hard to over-estimate.

Personal contacts made in the corridors and lounges and countless unofficial exchanges of view, make a UN session, particularly of the quieter type, a forum of perhaps unique value. Especially may this be true for the delegations of the newly independent countries, to whom the UN appears not only as the decisive force for world peace but also as the chief potential source of help for their own economic development.

Whatever form such help may take in the coming years – discussion of this was a leading theme at the recent session – it will be unfortunate if those who direct economic planning in the 'under-developed' nations and those who plan international help to them place so much emphasis on industrialisation as to forget that agriculture, and often the cultivation for the world market of a particular crop, will remain the chief source of prosperity and progress in many new nations for decades to come. In this connection it might be valuable if more members of delegations to the UN, particularly of the so-called 'young nations', were directly connected with the land.

Tailpiece

AT THE time of writing, the entries for this year's Grand National have just been announced and from now until the race is run at the end of March there will be a lot of speculation about which horse to back – as this annual steeplechase is the biggest race of the year in Britain. We are informed that Sundew, last year's winner, had cubes of dried lucerne included in his rations; and the Green Crop Driers' Association have recently claimed that there are properties, as yet unknown, of especial benefit to the health of animals in dried grass or lucerne. It seems that it might be profitable to enquire into the diet of this year's entries for the Grand National.

RICE DESTRUCTION BY CRABS

H. D. JORDAN, B.SC., A.R.C.S., A.I.C.T.A.
(West African Rice Research Station, Sierra Leone)

Crabs are troublesome pests wherever mangrove swamps are being developed. In West Africa, such swamps are being used for rice cultivation. This article describes the damage caused to rice by crabs in Sierra Leone and gives detailed methods of control evolved at the West African Rice Research Station.

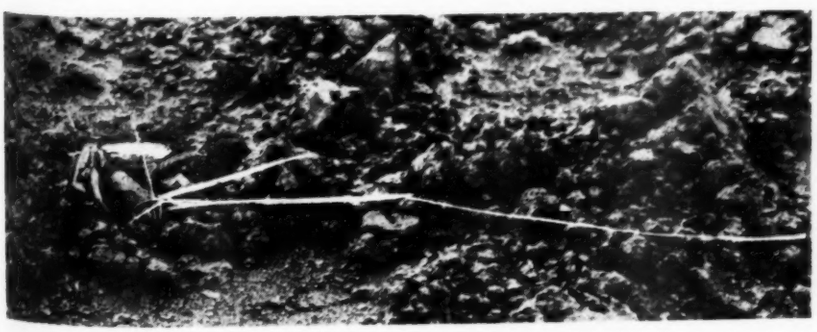
IN West Africa, there are considerable areas of tidal mangrove swamp which reach their greatest extent in the region from Cape Verde south to Sherbro Island in Sierra Leone, and in the Niger and Cross river deltas. In Sierra Leone, certain of these lands have long been used by the local farmers for rice cultivation, but in particular those of the Scarcies rivers area, where fresh water conditions obtain for a sufficiently long period for rice to be grown under natural water conditions.

The development of these mangrove swamps began at the end of last century and a survey carried out in 1930 showed that most of the land immediately suitable for the cultivation of rice was already under cultivation. This totalled 37,000 acres of tidal swamp on the Great and Little Scarcies, as well as a smaller area of non-tidal land. Yields on the tidal land were estimated to average 2,000 lb. paddy per acre, though yields of over 3,000 lb. paddy per acre have been obtained on the farm of the West African Rice Research Station.* Similar conditions obtain on the Konkoure river in French Guinea, and on the middle reaches of the Gambia river where development is now taking place.

Mangrove areas in the lower reaches of the major rivers are, in general, too saline for rice to be grown under natural conditions, and it is necessary to exclude salt water by means of bunds and to grow the rice as a rain-fed crop. This is the practice in Portuguese and French Guinea, and pilot schemes have been carried out in Sierra Leone. There are, however, problems involved in such reclamation, one of the most important of which is that certain mangrove soils on drying develop extreme acidity. Investigations into the causes of this are being carried out at the West African Rice Research Station and until such time as the problem is resolved, large-scale development by empoldering must be approached with caution.

Rice growing on tidal lands in Sierra Leone is therefore, at present, mainly confined to areas where the tide water is fresh for a sufficiently long period for a crop to be obtained, so that no control of free water movement is necessary. Experience has shown in fact that it is essential to have sufficient channels to allow the tide to ebb and flow freely over the land; areas with insufficient natural creeks have been improved by the

*Transplanting of rice is always practised owing to the soil and water conditions of this land.



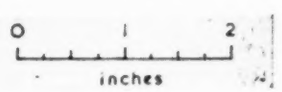
(Left) *A rice seedling being destroyed by a crab*

Sarmatium curvatum

Sesarma alberti

Sesarma angolense

Sesarma huzardi



construction of simple channels to allow this free flow. In general, however, the rice lands are dissected by innumerable branching creeks of all sizes, and it is along the edges of such creeks that crabs are most plentiful.

Extent of damage

The experimental station which is now the West African Rice Research Station at Rokupr on the Great Scarcies river was started in 1934 as a station of the Sierra Leone Agricultural Department. Damage was known to occur throughout the river area, but the early records show that although crab damage occurred, it was more or less confined to the edges of planted areas, adjacent to drains and bunds. (These bunds are not for water control but are merely for access.) These early experiments also showed that planting two or three rice seedlings to each stand gave the best results. The local farmers, however, still maintain their original practice of planting ten or more seedlings because of the damage done by the crabs—' one to grow and nine for the crabs '.

Patchiness of experimental plots due to damage done by crabs—the crab holes can be seen

Only comparatively minor damage was recorded on the farm until 1951, when crabs became very plentiful and the problem assumed major proportions. In this year, freshly transplanted seedlings on an area of about three acres near the river were completely destroyed by crabs within two weeks of planting, and seedlings, replanted in the area, suffered the same fate. Damage is caused by the crabs tearing apart the seedlings, just above ground level, and destroying the growing point. The leaves, so torn off, are taken by the crabs to their burrows. At one stage these three acres presented the appearance of 'Birnam Wood'* with an army of crabs marching off, each carrying a rice seedling.

Considerable damage was caused to experimental material on other parts of the farm, and in 1952 and again in 1953, the damage was serious. As for much of the experimental work, it is necessary to plant single seedlings, and as such losses could vitiate several years' work, reduction of crab damage was a matter of first importance, and investigation into crab behaviour and control was accordingly started.

**Macbeth*: Shakespeare.

Although crabs and other decapods are pests in many countries, the problem at Rokupr seemed very different from elsewhere. Crab damage in rice has been reported in India, but appears to be only of minor importance. Of much greater importance in most countries is the problem of damage done to bunds by crabs burrowing through them. Damage by prairie crawfish to cotton and other seedlings in the southern U.S.A. is the nearest parallel to the damage done by crabs to rice seedlings in West Africa.

Breeding habits

Hand collection and trapping in locally made wicker traps baited with cassava were carried out in 1951, and 17,000 crabs were caught and destroyed. A similar number were destroyed in 1952 and 32,000 in 1953, but it was apparent that this method of control was quite ineffective and had made no appreciable reduction in the crab population.

Collection was, however, continued in order to investigate the crabs' breeding habits and in a two-year period from 1954 to 1956 over 75,000 crabs were caught and examined. It was noted that one species, *Sesarma huzardi*, was causing most of the trouble, though two other *Sesarma* species, *S. alberti* and *S. angolense*, and a fourth crab, *Sarmatium curvatum*, were also present.

Examination of the daily collection figures over the two-year period, in which the numbers of males, the numbers of females and the numbers of females carrying eggs, were recorded, gave considerable information about breeding habits. Breeding apparently took place throughout the year, but only to a negligible extent during the rainy seasons – less than 2% of the females carrying eggs in September – as against over 30% in May. There appeared to be some correlation with temperatures which are higher in the dry season than in the rainy season. During the dry seasons, however, there was considerable fluctuation in breeding and detailed examination of the records showed the existence of two cycles. One of these (which is thought to be due to an internal breeding rhythm in the crabs as it could not be correlated with any external factor) showed

periods of maximum breeding at approximately 11-week intervals. The other, which was superimposed on this, showed a four-week cycle associated with high spring tides, when breeding was greater than at low spring tides.

Methods of control

Methods of control of crabs in use elsewhere seemed of little use at Rokupr. Trapping had proved ineffective. Treatments with slaked lime, tuba root, calcium carbide, carbon bisulphide and a turpentine-creosote emulsion, used in other countries, are all directed against crabs in their burrows, a practice quite impossible in view of the large numbers of crabs at Rokupr. It was thought that killing by poison baits, or spraying, would be the most promising line of approach, though this is complicated by the fact that the people draw their drinking water from the river and also engage in fishing. No widely poisonous substance could therefore be used.

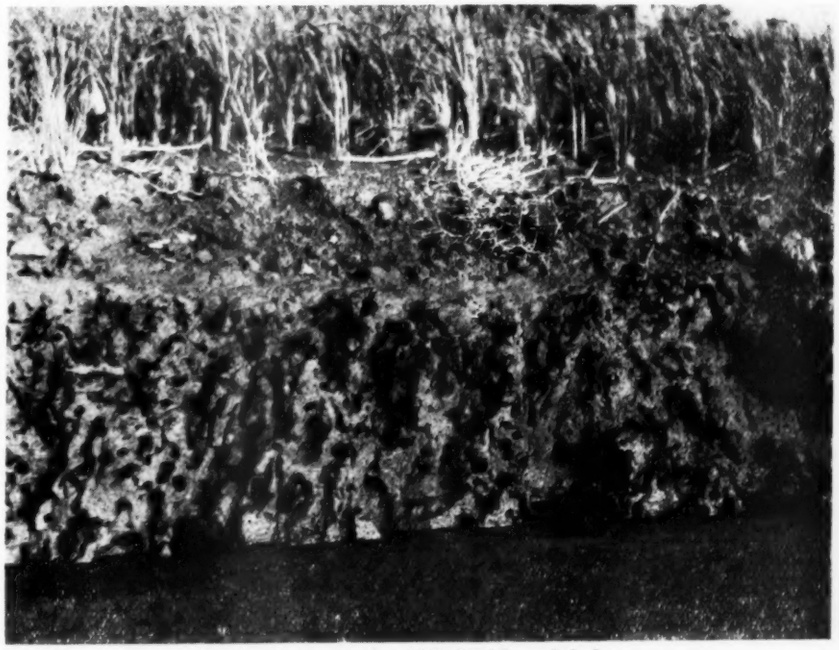
Trials were first carried out in the laboratory, using a number of substances, both as poison baits and as contact poisons. Technical BHC proved the most effective of the substances tested as a poison bait, but it has a powerful smell and crabs appeared to be repelled by it, though various bases for the bait were tried. Lindane (gamma BHC) was later tested and, since it has not the powerful smell of the technical product, may be of more use for poison baits. Technical BHC proved extremely effective as a control poison, low concentrations killing crabs on prolonged contact. Prolonged contact would not, however, be likely in the field, and tests were made of spraying. A concentration equivalent to 1lb. Agrocide dispersible powder (containing 6.5% gamma BHC as technical BHC) in 100 gal. of water was used. It was found that even if crabs were sprayed and then immediately washed in running water before being placed in clean water, death occurred within 24 hours.

Field trials were also carried out with poison baits and contact poisons. For these, crabs were confined in wire mesh cages which were sunk into the tidal swamp. Poison baits showed some effect, but it was suspected that the substances used had diffused into the water and acted as contact poisons. The most promising results were obtained with peeled sugar-cane which had been soaked in a suspension of technical BHC, under reduced pressure, and the treatment continued for several hours after the vacuum had been broken. Crabs were observed to feed on this bait after it had been well washed, and three days later half of them were dead or paralysed.

With spraying trials in similar cages, concentrations of Agrocide dispersible powder, equivalent to ½ lb. in 10 gal. of water and greater, were found to affect the crabs, 37% being dead and the rest paralysed, two days after the operation. A concentration of ¼ lb. in 10 gal. of water did not affect the crabs visibly though it stopped them eating the rice seedlings which were planted in the cages.

In these experiments the crabs themselves were sprayed. Under normal field conditions however this is unlikely to happen, as on the approach of anyone, the crabs will disappear into their holes. A trial of general ground spraying was therefore made using a concentration of 1 lb. Agrocide dispersible powder in 10 gal. of water, and a length of drain with its adjacent bund was sprayed with 4 gal. of this suspension. Very few crabs came into direct contact with the spray, although they were abundant in the drain before the operator arrived. This spraying was carried out as soon as the tide receded and the drain contained numerous puddles of water. Inspection was made five hours later and no active crabs were seen; small crabs were mainly dead and the larger ones dying. A count was made of these dead and dying crabs in 20 yd. of drain, of 5 ft. width, and 314 were recorded. A further inspection was made after 24 hours, when the tide had twice ebbed and flowed in the drain; a few active crabs were then seen, but dead and dying crabs were still very noticeable; many holes had dying crabs at the entrances and some affected crabs were even found many yards away from the drain. A similar spraying was carried out a few days later when the tide was rising and a light rain was falling but this proved less effective: some dead and dying crabs were seen after 24 hours, but there were still many active ones, particularly in the holes.

It is apparent from this that the conditions for spraying have to be chosen carefully. The optimum conditions occur after high spring tides in the dry season, when puddles are left on the ground and are not disturbed by following tides or by rain. These periods are shown from the daily collection figures to be the periods of maximum breeding of the crabs; so, from all points of view, they are the best periods for spraying. Routine spraying has been adopted at



The bank of a drain riddled with crab holes

the West African Rice Research Station and, since that time, crab damage has been considerably reduced.

Yet another line of approach to the problem was tried. Rice seedlings were treated with Agrocide in the nursery one week before transplanting and an experiment laid down to see whether this would make them unattractive to crabs. Treatments of Agrocide of ½ oz. per sq. yd. of nursery, and more, proved effective in reducing damage when there was an alternative food supply available. Damage in 24 hours by 20 large crabs in each 1 sq. yd. cage gave the following results, as an average of five replications.

Treatment	*Seedlings destroyed,* %
1 oz. Agrocide per sq. yd.	17.5
¼ ,, ,, ,, ,, ,,	16.3
½ ,, ,, ,, ,, ,,	16.9
¾ ,, ,, ,, ,, ,,	28.8
0 ,, ,, ,, ,, ,,	31.3

For valuable material, this type of treatment is now being employed, in addition to spraying.

Conclusions

Although spraying with technical BHC has given effective results at the West African Rice Research Station, it is doubtful whether its widespread use by the local farmers would be economic. It is possible however that this method of dealing with crabs may be of use in other countries where the local economy is different, and in particular where crabs do extensive damage to bunds and drains by burrowing. One benefit from its use is the high toxicity of BHC to mosquito larvæ. Crab holes are often breeding places for mosquitoes, and spraying with a suitable concentration of BHC would serve the dual purpose of destroying both the mosquito larvæ and the crabs. It is probable however that such a method will only be of use when there are puddles on which the spray will fall and into which crabs will later go.

Where crabs are troublesome under dry conditions, a more promising line of approach might be with poison baits using lindane and some attractive basis for the baits. DDT and Warfarin baits have been reported as effective in India, but did not appear as good as BHC baits at Rokupr. Lindane is more expensive than technical BHC and when sprays can be used, they are likely to be cheaper. This method should however be used with caution where the fish are economically important, as BHC is said to be toxic to fish. The only fish present at Rokupr when spraying was carried out were mud skippers, *Periopthalmus koelreuteri*, and these seemed to be quite unaffected by the spray.

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Hybrid Maize

Varieties of hybrid maize have been developed to suit climatic and soil conditions and special requirements. This advice on the choice of hybrid seed comes from R. W. Gunson (Seeds) Ltd.

IT has been found that with the use of hybrid maize, yields have been increased by 30%, or more, compared with open-pollinated varieties. This achievement is due partly to the higher productivity of the seed, partly to the better understanding of production methods, including almost 100% mechanisation, the use of more and better-suited fertilisers, and pesticides.

It is obvious that with a crop giving a 170-fold return (which is nothing extraordinary—records show up to 300-fold return) an initial outlay on better seed is a sound proposition. Out of the enormous number of hybrids which have been bred and produced in the U.S.A., Canada and in other countries the right variety to suit each farm must be chosen.

The decision whether it is to be grown for seed, for silage or for green feed is of prime importance.

The next most important problem is to find out the right type of hybrid with regard to its maturity. Maize being a very susceptible plant with regard to length of daylight, much harm can be done by using late varieties in conditions where earlier should be grown, and *vice versa*. Soil, temperature, rainfall and wind are also points to be observed, and especially under tropical and sub-tropical conditions it is important to distinguish between hybrids grown under dry-land conditions or under irrigation, the last involving higher returns to cover additional irrigation costs.

Hybrid seed producers can in most cases give the reply to all farmers' questions as hybrids have been developed suitable to most conditions. Breeders have successfully extended the growing area, mainly for silage, but also for grain, to parts of the northern hemisphere, where maize-growing was previously thought impossible, or at least uneconomical; at the same time hybrids have been developed which are very drought-resistant, and others which give a specially high return under irrigation.

The high germination, careful sizing and effective treatment of the seed with appropriate seed dressings has led to a very considerable reduction of the sowing rate. Under highly mechanised conditions in the U.S.A., the seed rate has been reduced by two-thirds, when grown for seed, and it is not more for the time being than 14 lb. per acre. Naturally, if maize is grown for silage and under less favourable conditions, the seed rate should be appropriately higher, but it will still be comparably less than that of the open-pollinated varieties.

As the production of maize is expanding in almost all areas and tends to replace in some parts of the world other fodder crops, less adaptable to mechanisation, the use of suitable hybrid seed is of growing importance to all farmers.

C. DE F.

Locust Research

Dr. T. H. C. Taylor, author of the article on 'Progress in Locust Research' which appeared in our February issue (WORLD CROPS, 1958, **10**, 45), has asked us to point out that the photograph at the head of the article is of an American grasshopper of the genus *Melanoplus*, whereas the article is concerned with locusts in the Old World. The photograph in question was not supplied by the author.

MAIZE IN THE U.S.A.

G. H. STRINGFIELD and M. S. ANDERSON
(U.S. Agricultural Research Service)

A sweeping change in the production of maize has occurred during the last 20 years. This has been brought about by the introduction and widespread use of adapted hybrids, the greater use of balanced fertilisers, heavier planting rates, and the mechanisation of the industry.

YIELDS have increased sharply. Before 1940 the average yield in the U.S.A. was about 26 bushels per acre. For the four-year period, 1949–52, the national average has been about 38 bushels and in the Corn Belt* a yield of 100 bushels to the acre is already common today.

Hybrid corn

Plant breeders in the U.S. Department of Agriculture are not only directing their work toward the production of higher yielding hybrids but they are also working on other characteristics of the plant. Varieties of hybrid maize are being developed to meet the climatic and soil conditions of particular areas. A high-yielding hybrid in Iowa might succumb to insects or diseases in Alabama, to leaf blights or stalk rots in Ohio, to early frosts in Winsconsin, or to heat in Oklahoma. Ranges of adaptability of hybrid varieties often are so limited that a high-yielding hybrid in one section of a State will return low yields in another section of the same State.

Since the introduction of hybrids, the total acreage planted with maize in the U.S.A. has decreased, but the total production and yield per acre have increased. The total acreage in 1949 was 83 million acres.

Climatic requirements

During the month of planting, the chief factor limiting growth is low temperature. Soil moisture, too, plays an important part. Too much rainfall delays planting and cultivation. Seedlings may rot in a cold, wet soil, while a shortage of soil moisture will delay seedling establishment.

Following planting, adequate rainfall and favourable temperatures steadily increase in importance until the plants reach the silking stage. The most critical period in soil moisture usage is just at the tasselling stage – a few days before silking.

Higher than average temperatures at pollination time are more likely to be harmful than beneficial to maize and the best antidote for extremely hot midsummer weather is ample soil moisture to keep the leaves unrolled, unwilted, and glistening.

Water conserved, that would otherwise be lost, can add bushels to the crop in all years except those with extremely cold, wet, early growing periods. An acre-inch of needed and conserved water on a full stand of growing corn is worth up to 12 bushels of grain, depending upon the severity of the need and the available mineral nutrients.

Examining a field of young maize in Kansas

Crop rotations

Various crops are rotated with maize so that the cropping system as a whole will maintain or improve soil productivity and soil structure. In the Corn Belt, maize generally fits well into rotations with such crops as small grains, soya beans, and sod crops. The kinds of livestock kept determine, to a considerable extent, the economic use that can be made of soil crops. Deep-rooted legume crops, including alfalfa, sweetclover, and *Sericea lespedeza* are particularly valuable in a rotation with corn. Their roots penetrate subsoils that do not have pan formations, and make use of moisture at lower levels. As these deep roots decompose they leave channels that improve water intake. Three sample rotations will serve to illustrate varied farm programmes in the large area where spring oats are grown.

A commonly used rotation that keeps 50% of the ploughed acres in maize is: maize first year; maize second year; oats third year; and clover, fourth year.

The same percentage of maize is sometimes grown in a two-year rotation that includes maize the first year, followed by oats and sweetclover. The sweetclover is turned under for green manure. Such a rotation is often used on farms, inadequately supplied with livestock.

On large, adequately stocked farms, the following eight-year rotation is sometimes used: First year maize;

*Corn Belt: The area from Ohio to Nebraska, and from southern Minnesota to north Missouri.

second year soya-beans; third year oats with sweetclover; fourth year maize; fifth year soya-beans; sixth year oats; seventh year alfalfa; eighth year alfalfa. This gives 25% of the acreage under maize at any one time.

Green manures

The Corn Belt is sharply limited in the kinds of green-manure crops that can be grown because of temperature conditions. Sweetclover is one crop that makes a satisfactory growth after small grains have been harvested. The nitrogen-fixing power of sweetclover is high, and the percentage of nitrogen is high in the plant tissues. With normal rainfall, the growth above ground will range from 1½ to 3 tons per acre on a dry-weight basis. A substantial root system equal to about one-third of the above-ground weight will also contribute to the organic matter of the soil.

In the south, winter cover crops are essential following row plantings of any kind, as they retard surface erosion and prevent winter rainfall from leaching out the plant nutrients in the exposed soil. Growing conditions are favourable for a wide variety of legumes suitable for use as green manures. Crimson clover, alone or with grains, is perhaps the most widely used.

Animal manures

In the Corn Belt, manure is best applied to the land just ahead of the corn crop in a rotation, and particularly before second-year corn. Even then, the benefits from the manure will come largely through increased yields of maize after the clover is turned under.

Applications of manure at rates up to 20 tons per acre may be very profitable, but few farmers have enough manure to cover their land at such a high rate. Commonly, manure is applied at the rates of 8 to 12 tons per acre.

Chemical fertilisers

In the Corn Belt, where considerable quantities of farmyard manure are available, 8 to 10 tons are often applied before the ground is ploughed for planting. Frequently this is followed by row applications of fertiliser of 3:18:9 or 0:20:10 grade at rates of 250 to 300 lb. per acre. Many farmers prefer to supply a part or all of the phosphorus needs by applications of raw rock phosphate at a rate of perhaps 1,000 lb. per acre, once in 8 to 10 years.

In the south-eastern States, where animal manure is in scant supply, fertilisers with a 1:1:1 ratio are often used.

Nitrogen fertiliser requirements for maize vary widely in different parts of the U.S.A. On dark soils from Nebraska through Pennsylvania and northward, supplemental nitrogen may be unnecessary, if the corn follows a good crop of sweetclover or a legume meadow. On irrigated soils, it is profitable to apply additional nitrogen on already highly productive soil where stands are increased to as many as 18,000 plants per acre.

On light-coloured northern soils, it is profitable to add chemical nitrogen in amounts up to 100 lb. per acre. This is specially important if manures or legumes are not used and if only trash, straw and non-legume sods are ploughed down.

In the area immediately south of the Corn Belt, and in the Cotton Belt, heavy nitrogen fertilisation is necessary, regardless of soil type and cropping system. Applications, both at planting time and after the crop is up and actively growing, are necessary.

Anhydrous ammonia and other liquid forms of chemical nitrogen are now widely used for fertilising maize. These compare favourably in cost and effectiveness with solid forms of nitrogen.

Foliar diagnosis

Deficiencies in plant nutrients are shown in various ways by the plants during the growing season. The lower leaves show certain deficiency symptoms first. They should stay green until the crop is practically mature. Early dying along the leaf edges toward the tip indicates potassium deficiency. Purpling of the leaves of young plants, usually accompanied by slow growth, indicates phosphorus deficiency. When these symptoms appear, it is too late to remedy the deficiencies during the current year. Treatment for the next growing season is indicated. Yellowing and dying along the midrib in a widening band toward the leaf tip is typical of serious nitrogen deficiency. Nitrogen hunger in young plants is shown by an anæmic yellow-green colour of all leaves. The deficiency can be remedied during the current season by applications of nitrogen at this stage of growth.

Preparing the land

Certain phases of seedbed preparation may begin a year or more before the seed is planted. Installation of diversion ditches or terraces may be advisable on sloping land. Fields may need rearranging to make possible the planting of rows on the contour rather than up and down slopes. If a field slopes as much as 5 or 6 ft. per 100 ft., or if there is evidence of erosive action on even milder slopes, a need for stripcropping may exist. In some places, long slopes of only 2% may require contour planting or perhaps stripcropping.

If the soil is one that forms a hard crust after heavy rains, the cropping system may need adjustment so that maize will follow a soil-mellowing grass or legume sod rather than a tilth-depleting inter-tilled crop, such as maize, cotton, or soya beans. Liming, where needed, starts off a chain of biological and physical activities that tends toward a mellow workable soil.

Ploughing

The objects of ploughing the land are to cover trash and break up the soil, so that a mellow seedbed can be prepared.

Ploughing overwet soil often leaves large unmanageable clods, especially in soils of fine texture and low organic content. The soil is too wet for seedbed preparation when the furrows turn up shiny and fail to crumble during ploughing or if a handful of upturned earth can be squeezed into a ball that sticks together.

Some clay soils will become mellow only if they are ploughed in the autumn. This, however, is not advisable on soils that are subject to winter erosion. Silt loams ploughed in the autumn often become compact again in the winter and require re-ploughing or extensive stirring in the spring.

Final preparation

In the drier areas, final preparation of the seedbed may begin as much as three to four weeks before planting. The tools may be the disk and spike-tooth harrow, the one-way disk plough, the field cultivator, or the lister ridge buster. Newly germinated weeds can be killed by tillage just before planting.

In the more humid areas toward the eastern part of the U.S.A., ploughing is often delayed by wet soil. Seedbed preparation then must follow soon after ploughing. The disk and the spring-tooth harrow, followed by the spike-tooth harrow and sometimes by the culti-packer, are the commonly used implements.

The disk kills weeds, loosens and partly smooths the surface, but packs the lower ploughed layer. The spring-tooth harrow loosens the surface, kills weeds, and has little compacting effect, but it may bring too much trash to the surface. The spike-tooth harrow smooths, kills small weeds, and has little compacting effect. The culti-packer crushes reasonably soft clods, compacts the upper part of the ploughed layer, leaves the surface of a mellow soil in smooth little ridges, but kills few weeds.

Mulch tillage

Mulch tillage, also called trash mulching, leaves most of the surface residues above ground as the soil is being prepared for planting. Special furrow openers have been devised for planting through the residues.

Mulch tillage may be done with a one-way disk plough followed by a rod weeder. Also heavy V-shaped blades, or the small sweeps of heavy field cultivators, may be drawn a few inches under the soil surface, lifting and loosening the soil but not turning it.

The use of mulch tillage for corn appears to be limited to dry regions, porous soil, and sloping land, where erosion is important. It reduces run-off and erosion by protecting the soil surface from puddling by rainfall and from exposure to wind.

Planting

Corn generally is planted ten days to two weeks after the average date of the last killing frost in any particular locality. A delay of two days in planting will normally delay silking and maturity about one day on the average. Light soils, good drainage, and good crumb structure favour early planting. Early planting may be advantageous when the soil is dry enough for good coverage, if weather forecasts indicate that temperatures will remain above 60°F., and if there are no probable local hazards such as floods or infestations of cutworms, budworms, or corn borers.

A mechanical corn picker in use. It knocks down the stalks and gobbles up the maize cobs, which are drawn up through the machine and loaded behind. Maize is usually harvested after the first heavy frost

The right stand is more important than a strictly uniform stand or a particular method of planting. The most productive stands range roughly from 6,000 to 20,000 plants per acre. They should be heavier for earlier and smaller hybrids, shorter seasons, and higher moisture supply and soil productivity. Thick stands result in easier weed control, but more lodging and smaller ears.

The essential mechanism of modern corn planters is a cylindrical hopper with a revolving plate at the bottom. The seed passes through cells (holes or edge notches) in the plate. The planting rate is determined by the size and number of the cells and the revolving speed of the plate. The correct plate selection is the key to controlled planting rate. Plates designed to select one seed at a time require well-graded seed.

Seed corn should be placed in close contact with warm, moist soil and with enough covering for reasonable protection against birds, rodents, and surface drying. Quick germination and quick seedling emergence mean less trouble from soil-borne insect and disease pests or from crusted soil. Because soil warms and dries from the top down, the preferred planting depth increases as the planting season advances. One inch under settled soil is shallow planting; 3 in. is deep. The depth of the root system is not increased by planting depths greater than 1 in.

Surface-planted corn may be in checkrows (rows in two directions at right angles), drilled one seed in a place, or hill dropped. Checkrowing requires skilled operation and more time than drilling or hill dropping, but it permits cross cultivation which often is advantageous in controlling weeds. In hill dropping, two or more seeds are dropped together without regard to cross rowing.

Row spacing has become standardised at about 38 to 42 in. in the central, northern, and eastern States along with the standardisation of other row-crop equipment. There is usually no advantage in spacing rows closer than 40 in., except on soils of very low productivity.

Preparation with planting

Systems that combine soil preparation and seed planting may save time and labour. They also permit planting in short periods of good weather, which often is highly important.

Lister planting is the nearest practical approach to a one-operation system. The seed is planted while the soil is being stirred. Lister planting often is preceded by blank listing of the soil or by disking, or ploughing. The lister is essentially a plough with a double mouldboard that opens a furrow and throws the soil to each side. A planting attachment drills the seed into the furrow. The ridges of loose soil cover trash and small weeds between rows. Special disk cultivators throw the soil out of the furrow during early cultivation, and in the final cultivation they level the ridges and remove the soil into the furrows where it buries the weeds after the corn plants are larger.

Listing is not favoured in northern areas having roughly 30 in. or more of annual rainfall because of the slow germination and seedling growth in the cold soil of the furrow bottoms. In drier areas listing often is superior to surface planting in dry seasons.

Uniformly large, well-matured ears are typical of hybrid corn. Many varieties are developed especially to suit differing climatic and soil conditions

Cultivating

The main purpose of cultivation is to kill weeds. Weeds are easiest to control by mechanical means when they are very small; if possible, even before they can be seen above ground. The most economical and efficient implements for early cultivation of easily worked soils are the spike-tooth harrow, the spring-tooth weeder, and the rotary hoe. Many annual weeds are destroyed when the maize is cross-cultivated by these implements before it has emerged and again between emergence and the five-leaf stage.

These tools have little effect on well-established perennial weeds, or on annuals such as the cocklebur that can germinate well below the soil surface. The rotary hoe is especially useful in breaking a crust on the soil surface, so checking the effects of wind erosion.

The shovel cultivator is still the most effective implement for early cultivation of soils that are difficult to work, and for corn larger than the five-leaf stage.

The ' duck foot ' cultivator sweep which runs nearly flat under the surface is the most generally useful type of shovel. Such sweeps cannot be kept in hard soil, however, except with heavy tractor cultivators. Pairs of disks, one on each side and next to the row, called disk hillers, are highly effective for late cultivations, for controlling vine weeds, and for cultivating trashy ground.

Chemical weed control

Formulations of 2,4–D, applied as sprays, give the best field control of weeds in maize. They can be used before the plants emerge, after they have emerged, and during the lay-by period.

Combinations of pre-emergence and post-emergence treatments are often used to achieve long-term control. In such cases, the pre-emergence sprays, which are applied at heavier rates, control annual grasses and broad-leaved weeds for periods of five to seven weeks; the post-emergence sprays control the broad-leaved weeds that germinate after the effects of the first treatment have dissipated.

Pre-emergence treatments are effective in most areas and on most soil types. Pre-emergence sprays should not, however, be used on sandy loams or lighter soils. There is danger of too deep penetration and injury of the germinating corn on such soils. Soils high in organic matter require higher rates of application than those low in organic matter. Dry weather after pre-emergence treatments lessens their effectiveness; an excess of rain increases their effectiveness.

Post - emergence sprays (overall sprays) are applied at rates of about $\frac{1}{4}$ to $\frac{1}{2}$ lb. of 2,4–D per acre. Ester formulations should be used at the lower rate and amine salt formulations at the higher rate. Spraying after emergence is done usually when the corn is 6 to 10 in. tall.

Insects

An important factor in reducing insect damage to maize is the choice of well-adapted hybrids. In general, a plant has a better chance of escaping with little or no injury if it is adapted to its environment, well fertilised, and so capable of making vigorous growth. The European corn borer, however, concentrates on the better fields and the better plants within a field. Maize breeders have countered by developing hybrids with relatively high resistance or tolerance, or both, to the borer. Resistant hybrids, where available, will do much to reduce losses by this pest.

Crop rotation tends to suppress certain soil-inhabiting insects like rootworms and root aphids that prey on maize. On the other hand, wireworms, cutworms, sod webworms, and white grubs thrive in grass sods. In such cases delayed and thicker planting to allow for some losses is usually better in the long run than giving up otherwise beneficial rotations.

A number of powerful insecticides have been introduced in recent years. They are variously used – in poisoned baits, sprayed or dusted on plants or seeds, mixed with the soil, or even applied with row fertilisers.

Diseases

The principal diseases of maize are smut and various rots, rusts, blights, and wilts. They are caused either by fungus or bacterial infections. The use of resistant hybrids is the best means of controlling most of these diseases. Another important factor in controlling some diseases is a well-managed soil in which fertility is properly balanced. This requires the use of recommended rotations, maintenance of adequate amounts of organic matter in the soil, proper drainage, and fertilisers and lime when they are needed.

Seedling blights attack the seedlings as they emerge from the soil. They are best controlled by (1) planting mature, uninjured, uninfected seed, (2) providing soil conditions that

favour quick germination and rapid seedling growth, and (3) seed treatment with an effective fungicide.

Smut, a common disease of maize, is caused by a fungus and is characterised by irregularly shaped galls that may appear at any stage of growth on the stalks, ears, and tassels.

Stalk rots usually, but not always, gain entrance beneath the soil and invade the stalks upward. Their severity depends on the earliness of infection and the speed of invasion. In general, early-ripening hybrids are more subject to stalk rot than full-season hybrids.

Maize is subject to a number of ear rots and kernel disorders. Contributing factors are poor husk cover, deep soft-starch grain, growth cracks in kernels, and weather conditions that delay drying of ears in the field. Control measures that can be applied on a field scale have not yet been developed, but certain hybrids are more resistant than others.

Epidemics of leaf blight diseases often cause losses in yield in the warmer and more humid corn-growing regions. The causal organisms may be bacteria brought in by flea beetles or fungi brought in by wind.

Harvesting

Maize is harvested for grain, silage, or fodder, and occasionally is cut and fed green.

Maize silage makes the most complete use of the crop. An acre of ensiled maize has about one-third more feeding value for beef cattle than an acre harvested for grain. Maize for silage is cut early enough to seed the land to winter wheat. When harvested and shocked, the crop may be used as fodder or the ears can be snapped or husked. The field silage cutter and mechanical dumping or unloading devices have eliminated most of the hand work in silo filling.

A sizable acreage of maize, particularly in the Corn Belt, is harvested by hogs. Two to five acres are enclosed with an electric fence and 40 to 60 hogs of perhaps 125 lb. in weight are allowed to feed on the crop. The fence is then shifted to an ungrazed portion of the field.

Harvesting of maize for grain in the Corn Belt is now largely mechanised. Even in 1952 about two-thirds of the maize harvested in the U.S.A. was gathered by machinery.

One man with a 2-row picker can gather the ears from an acre of corn and deliver the ears to a wagon in 40 to 45 minutes, whereas it usually takes one man about a day to husk an acre from standing stalks by hand and still longer to husk it from the shock.

Several types of corn picker are now available. The most common are the 1-row type, which may be tractor-mounted or self-propelled. The picker-husker snaps the cob from the standing stalks, removes the husks, and delivers the ears to a wagon, pulled behind or to one side of the picker, or into a truck. A multi-purpose machine – the picker-sheller – is now being introduced. It picks, husks, shells and delivers the corn into the hoppers or to accompanying vehicles, all in one operation. The maize, so harvested, usually requires mechanical drying.

Mechanical drying

The grain generally contains from 15 to 25%, or more, of moisture in the kernels when picked. This is too high for safe storage in a tight bin.

It is dried mechanically by forcing air through cribs or bins that have been adapted or designed for that purpose. Equipment now in use permits the drying of either shelled or ear corn. Some driers employ unheated air and others use air heated by furnaces burning coal, fuel oils, natural gas, or bottled gas.

With heated air it is possible to dry maize cobs having a kernel moisture content of 35% or more. Cobs with moistures up to 28% have been shelled with little evidence of crushing, and then dried.

Abstracted from a Farmers' Bulletin published by the U.S.D.A.

Coming Events

Sugar. The IVth International Sugar Exhibition will be held in Amsterdam, Netherlands, from 22–30 April. Particulars may be obtained from the Organisers, Marnixstraat 380, Amsterdam.

International Agricultural Machinery and Equipment Exhibition. This exhibition will be held from 4–11 May in Brussels. Enquiries should be addressed to the Secretary, 29 rue de Sap, Brussels 4, Belgium.

Crop Protection and Pest Control. An exhibition sponsored by WORLD CROPS is to be held from 12–15 May at the Royal Horticultural Society's New Hall, London, S.W.1.

The 2nd International Congress on Pest Control is to be held in Vienna from 14–18 May. Further particulars may be obtained from Sekretariat des II Internationalen Schadlingsbekampfer-Kongresses, Rosensteingasse 79, Vienna XVII, Austria.

Silage. An opportunity to study recent developments in machinery and the methods used in silage making will be provided by a National Silage Demonstration on 21 and 22 May near Basingstoke, England, to be organised by the Shell Chemical Co.

Agricultural Engineering. In co-operation with the N.I.A.E., the British Council is organising a course for suitably qualified overseas specialists on recent advances in agricultural engineering, to be held at Silsoe from 1–14 June.

Seed Crushing. The International Association of Seed Crushers is holding a Congress at Brussels from 2–6 June. Further particulars may be obtained from Laurent Pleeck, c/o Federation des Fabricants d'Huiles de Belgique, 121 rue Royale, Brussels.

Sugar-beet. An International Federation of Sugar-beet Producers will be held in Germany in June. Details may be obtained from 73 rue de Miromesnil, Paris 8^{e}, France.

Mineral Nutrition of Farm Animals. A course on this subject, principally for overseas graduates in agricultural science or veterinary medicine, will be held in Aberdeen, Scotland, from 15 June to 3 July. The course is being organised by the British Council, 65 Davies Street, London, W.1.

Royal Show. The Royal Show will be held this year at Bristol from 1–4 July.

Grassland Agronomy. A course for overseas specialists will be held at the Grassland Research Institute, Hurley, from 6–19 July. It is sponsored by the British Council and aims to bring together specialists from all parts of the world to discuss the techniques of grass and animal experimentation as well as the wider field of increased production from grass.

CEREAL PRODUCTION IN BRITAIN

F. R. HORNE, M.A., N.D.A., N.D.D.(HONS.)
(Director, National Institute of Agricultural Botany)

Technical inspection of cereal seed crops enables high-quality field approved or certified seed to be produced

Cereal yields in Britain have increased in the last 25 years by some 38% in wheat, 41% in oats and 48% in barley, according to the annual estimates of yield per acre published by the Ministry of Agriculture.[1]

THE increase in yields of grain per acre can be attributed mainly to: (1) improved crop varieties, (2) increased use of fertilisers, (3) better cultivations assisted by mechanisation, (4) control of pests and diseases, (5) better weed control, (6) introduction of ley farming, and (7) improved crop rotations.

The acreages devoted to cereals rose from a low figure in the 1930s to a peak during the war. Barley has largely maintained that level, but wheat and oats are now back very much to the same acreage as in the mid-1930s. With the increased productivity of each acre, actual grain production is much higher than it was 25 years ago.

The use of improved crop varieites has perhaps been the most important single factor in increasing yields. Trials at the National Institute of Agricultural Botany of modern against older varieties show improvements in yield of some 20 to 25%,[2, 3] so that about half of the yield increase may be credited directly to the plant breeder.

Use of fertilisers

They have also made it possible for farmers to take advantage of other aids to higher yields. For instance nitrogenous fertilisers are more effectively used on varieties with stiff straw and with higher resistance to those diseases which may be troublesome in crops with luxuriant leaf growth.

Surveys[4] made ten years ago showed that quite 50% of cereals in Britain received no nitrogenous dressings. Since then, the use of *nitrogen* has almost doubled, and consumption has increased five- or six-fold since before the war,[5] especially in the heaviest cereal-growing areas in the south and east where the rainfall is generally lower. Norfolk, for example, in 1955–6 used 40 lb. of nitrogen equivalent per acre.[6] Investigations at Rothamsted[7] and elsewhere show that the return from the first 28 lb. of nitrogen equivalent per acre averages between 2 and 3 cwt. of grain.

Of special importance in the use of nitrogen has been the time of application. While the shortest modern varieties need heavy dressings at sowing to ensure that a sufficient area of green foliage is produced, the tallest varieties of wheat and oats can best be given part as a top dressing at a later stage. Recently there has been keen interest in the effect of late nitrogen dressings in improving the protein content of grain for feeding to livestock.

War-time cropping of land which had long been under rough grazing helped to draw attention to serious shortages of *phosphate*, and the consumption of phosphatic fertilisers is now at twice the pre-war level.[5] Some of the heavier soils were at first so deficient in phosphate that cereals were stunted in growth and characteristically purple in colour.[8] Investigations have shown that the plant must absorb most of its phosphates in the first few weeks of growth, so that drilling fertiliser and seed together, using the combine drill, enables the young cereal to obtain the phosphate it needs, even though the soil between the drills remains deficient.

Potash has proved to be a limiting factor on chalk and other lighter soils.

Cultivations

Cultivations on the heavier types of soil 25 years ago were often too late, especially in spring, and many partial crop failures resulted. Nowadays, with the use of crawler and other high-power tractors, the work can be done at the proper time leaving a well raised furrow slice to weather and dry out during the winter. In Britain,

droughts rarely cause poor crops so long as cultivations are completed in good time.

Drainage schemes were encouraged by the intensive cropping programme of the 1940s and have played an indispensable part in the cultivation of many of the flatter and wetter fields. Nearly half a million acres were tile-drained from 1939 to 1950.[9]

Pests and diseases

Cereal crops in the past were often destroyed by soil pests, such as wireworms and leatherjackets. Nowadays seed is nearly always dressed before sowing, often with insecticidal as well as the usual fungicidal compounds. *Helminthosporium*, which formerly caused great losses in young plants, and covered smut or bunt, which affected both quality and quantity of wheat and other cereals, are now almost unknown.

Unfortunately the majority of cereal diseases cannot be controlled once the crop is infected, and some can only be prevented by carefully planned crop rotations. Resistant varieties represent the best protection against yellow rust and loose rust.

The Norfolk four-course rotation of roots, barley, clover, wheat, so successfully employed for more than a century has begun to give way to intensive cropping to produce more wheat and barley for sale off the farm. Diseases, such as Eyespot (*Cercosporella*) and Take-all (*Ophiobulus*) and attacks by the Cereal Root Eelworm, have shown the dangers of trying to grow too many cereal crops in rotation.

The work of Stapledon and others has established ley farming as the most productive farming enterprise on many British soils. Instead of the manually-operated sheep fold, strip grazing of grass-clover leys and kale by cattle, bring the much needed rest from wheat and barley. Leys also improve the crumb structure of the soil on which success in cereal growing so often depends.

The use of chemical herbicides has also produced spectacular results. In some areas the increase in cereal yield has been not less than 10%.[10]

Spring and winter varieties

In Britain, the climate suits winter varieties of cereals. Spring wheat was most unpopular in Britain, until in 1940 the Swedish variety 'Atle' became available with a yielding capacity and stiff straw to compare with a good winter wheat.

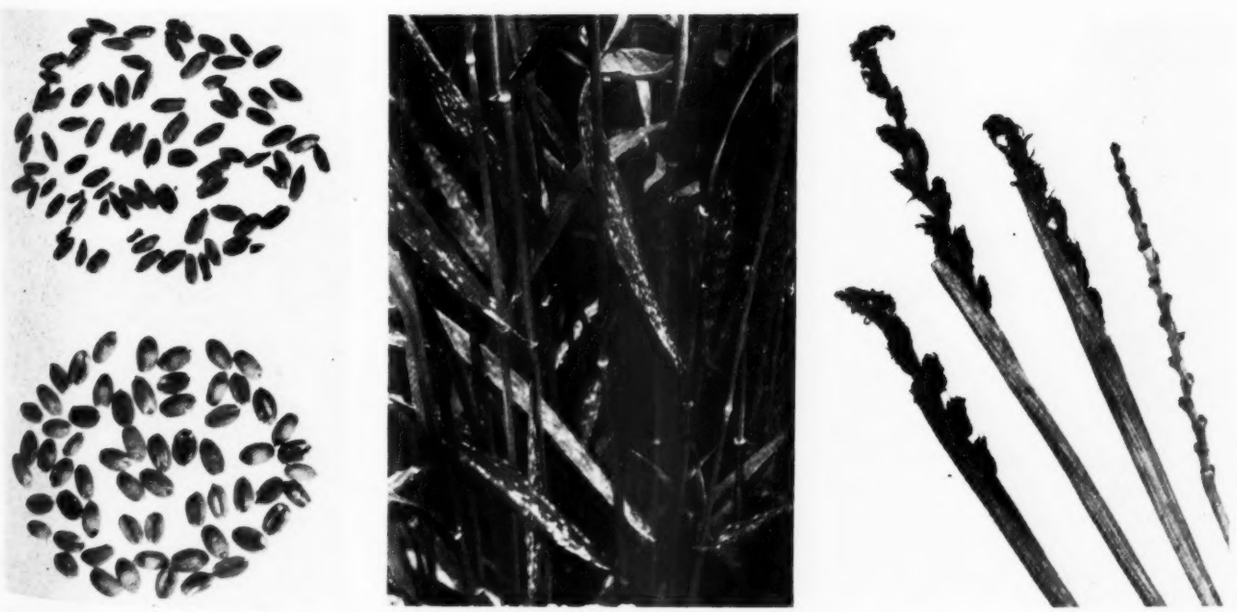
More recently, several new spring varieties have come along which outyield older kinds, and ripen early, so that spring wheat can be sown in the west and north. As in other countries the spring wheats tend to be higher in milling and breadmaking quality than winter wheats, and they now cover more than a third of the acreage under wheat. Even with improved modern varieties, the spring crop tends to average between 10 and 30% less than modern improved winter wheats.

Spring wheats are, however, often preferred to winter wheats because they are less liable to lodge on the most fertile soils, and infection with certain seed-borne diseases such as ' eyespot ' is often less serious. The later ripening helps to extend the period of harvest, and they can be sown where winter conditions are too cold or too wet, or when the weather has delayed winter sowing. Spring wheats are useful too in fields infested with wild oats, wild onion or other weeds not so far susceptible to chemical herbicides, which require a long series of spring crops for their control.

Improved wheat varieties

Older kinds of winter wheats such as ' Squarehead's Master ,' have been entirely replaced[11] by high-yielding French types, with stiff straw. Unfortunately many of these lack the quality needed for bread or biscuit manufacture in Britain. Recently, British private breeders have introduced varieties such as ' Dominator ' which combine high yield with excellent breadmaking quality. The substantial increase in the production of biscuits since the war gives the plant breeder a special opportunity.

The combine-harvester has exposed many weaknesses in older varieties. Apart from the need for a stiff and



Some cereal diseases: (Left) *Yellow rust, when severe, causes shrivelled grain.* (Centre) *Susceptibility to mildew reduces yields and renders the straw more liable to lodging.* (Right) *Loose smut reduces yield*

tough straw, it is important that the grain should not shed from the ear as the crop ripens.

Combines are a great convenience to the farmer, but they have tended to reduce the quality of the grain sample by including impurities, and by damaging the grain, which often has too high a moisture content. Any tendency to sprout in the ear may be revealed when wet weather delays harvest, particularly in the white-grained wheats.

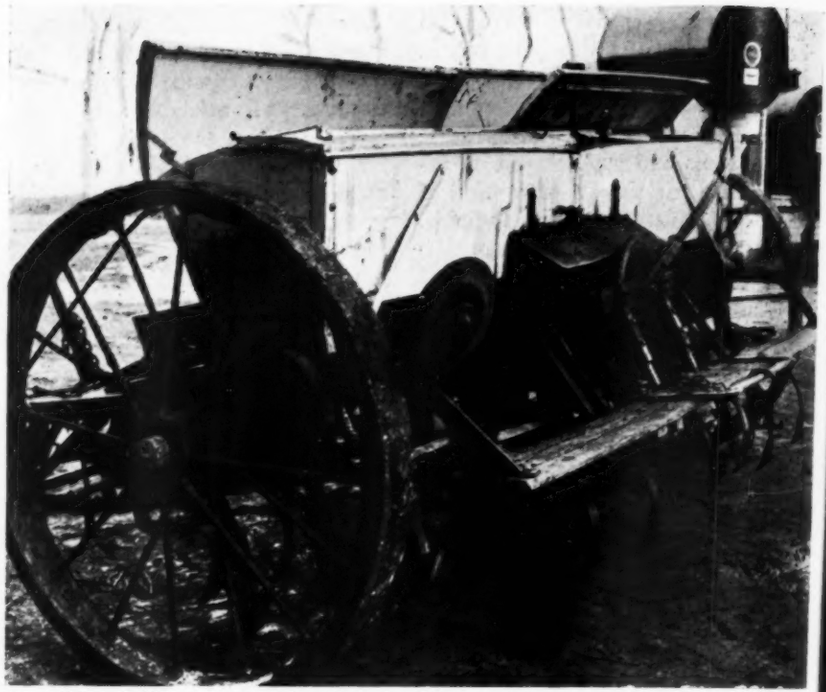
Barley varieties

Big changes have occurred in barley varieties. While spring barley was grown chiefly in Britain on the poorer classes of land following a root crop, the old varieties such as 'Spratt-Archer' were well adapted to the conditions. Quite different barleys such as the Scandinavian 'Kenia' were, however, needed to suit the more fertile soils where barley could be a change from wheat or oats. New hybrids developed during the past ten years first adequately met the needs both of grower and consumer. Meanwhile the total barley acreage has doubled since 1939 with no corresponding increase in the use of barley for malting which now represents less than a quarter of the total crop. 'Dual-purpose' hybrids which suit both maltster and cattle food manufacturer greatly help the farmer and have brought a significant rise in the average yield.

Following the early work of Russell and Bishop[12] which showed that quality and yield of barley can be improved by early sowing, many farmers in the south now sow barley before Christmas. Except in very severe winters, good crops are obtained, with the added advantage that the harvest is ready before other cereals, and while the maltster is still replenishing his stocks at the beginning of the season.

Varieties of oats

The Welsh Plant Breeding Station has achieved increased yields of more than 15% in winter oats compared with the Old Grey Winter.[13] At the same time the straw is stiffer and the white husk colour is much more popular with manufacturers of oatmeal for human consumption. Winter oats are chiefly grown in the driest parts of southern England where heavy soils or spring droughts may make spring sowings more hazardous.



A combine drill for sowing phosphate or other fertiliser in commercial cereal crops in close proximity to the seed

In Britain the spring oat crop is more evenly distributed than any other cereal. Plant breeders in Wales, Sweden and Holland have produced varieties with good yields and with stiffer straw.

Stem eelworm when it occurs causes great damage to both winter and spring oats and some of the newer Welsh oats have special value for their resistance to this eelworm. By their use the risk of crop failure on some of the more heavily-cropped soils has been greatly reduced.

Cereal mixtures

As might be expected on general ecological considerations, mixtures of oats and barley give appreciably higher yields than the pure crops sown apart.[14] The yields are more consistent from year to year, a matter of great importance on the stock farm where mouths must be fed whatever the season. While barley is the more resistant to drought and to manganese deficiency, the oat crop is more tolerant of deficiencies of lime.

Seed production

Cereal seed is bulky and expensive to transport, so farmers tend to produce much of their own requirements on the farm. As wheat, barley and oats are mainly self-pollinated they can, unlike herbage and vegetable varieties, be multiplied for several generations without reduction of quality. Surveys have, however, shown that appreciable proportions of seed wheat, barley, and oats, sown on farms, are mixed or not true to name.

An important development has been the introduction of schemes for the improvement of seed stocks. Nearly 100,000 acres are now inspected each year in the Cereal Field Approval Scheme,[15] where co-operation between seed merchants, farmers and technicians has had a valuable influence on the quality of seed available to the farmer.

Possible future trends

Economic conditions, though difficult to assess, have undoubtedly influenced the growing of cereals in Britain. When cereal prices are low and demand uncertain, farmers may be driven to put large areas under grass. Guaranteed prices for cereals have enabled farmers to plan their acreages ahead and to spend more on such items as improved seeds, fertilisers and drainage to improve the output from their land. Variety remains the farmer's cheapest way of increasing yield, and there is still plenty of scope for further progress by the plant breeders.

In fact, while yields over three tons to the acre have been authenticated, the national average of little more than one ton per acre leaves room for improvement in many directions.

There is likely to be increasing pressure towards an interest in quality in wheat and other cereals. The market for British grown grain must ultimately depend on competitive prices in relation to world supplies. The plant breeders are working to produce grain better suited to the consumer's needs, for bread, biscuits, malt or fodder. The successful farmer in his turn is already giving more attention to ensuring that his crops are marketed as clean and wholesome grain of low moisture content.

Further advances in the use of chemical herbicides to kill some of the worst weeds, at present untouched, are likely to raise yields and assist in the production of clean cereal crops.

Further increases in mechanisation, particularly at harvest, are likely to emphasise some existing problems. Though the combine harvester reduces costs, it emphasises the need for attention to grain storage, cleaning and drying.

The combine drill provides opportunities for making the best use of our increasing knowledge of how the plant utilizes the wheat nutrients. At the higher levels of plant efficiency new factors are likely to restrict growth. For instance, recent trials have shown that added nitrogen under modern conditions of fertile land sometimes produces no improvement in yield.

Improvements in rotations to reduce the ravages of Take-All and Eye-Spot are already being made on a large scale. The plant breeders are concentrating on varieties resistant to such diseases as mildew and the various types of eelworm.

Cereals offer highly concentrated starchy foods, which can be used to supplement home-grown grass and leguminous products for cattle, as well as for human consumption. With high yields and prospects of lower costs, there seems no reason why cereal growing in Britain should not be maintained at a high level. Possibly within the next 25 years, world advances in human population will encourage the production of still greater acreages of cereals in Britain for home consumption.

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Cereal seed offered for sale is normally given a fungicidal dressing before sowing

Protecting Stored Grain

Losses of grain through pest infestation can to a large extent be prevented by providing clean, moisture-proof and vermin-proof storage.

The first step in obtaining cleanliness is the removal of all old grain from the harvesting machinery, with particular attention being paid to those places where it is likely to accumulate.

Clean bags should be used, but if that is not possible all old grain should be shaken out of bags which have already been used. If weevil infestation of the bags is suspected, they should be treated by one of the following methods:

(1) Boiled for five minutes and then hung out to dry.

(2) Fumigated in a 44-gal. drum with 1 fl. oz. of carbon bisulphide for 48 hours.

(3) Dusted with BHC and left in a heap overnight.

All silos and storage sheds should be thoroughly sprayed with an insecticide such as BHC, DDT or dieldrin before the grain is put into them.

Fumigation should be carefully carried out, and is recommended for all grain intended to be used as seed.

Grain should be fully mature and dry before it is stored, and if any doubts exist it should be left in the paddocks for a few days to ensure complete dryness.

It is preferable to store old and new grain separately and all old grain should be removed from a silo prior to the introduction of the new.

Where considered desirable, grain can be fumigated by the addition of insecticidal dusts or fumigant tablets while the silos are being filled.

This should ensure considerable protection, but in any case the silos should be inspected at least once a month during the summer to check for weevil infestation.

Source: New South Wales Department of Agriculture

Pests of Cereal Crops

Further abstracts of papers read at the IVth International Congress on Crop Protection recently held in Hamburg

Weed Control in Turkey *by N. Goksel, Ankara (Turkey)*

The presence of weed seeds such as mustard, ragweed, corn cockle, Syrian scabious and yellow weed reduce the market value of Turkish wheat. The annual loss caused by such weed seeds is not less than 19 million Turkish lira. Analysis of the weed flora in Turkey shows that a large percentage of the most pernicious weeds are some native species, *e.g. Cephalaria syriaca* and *Boreava orientalis*. A *Cephalaria* plant produces on average 100–300 seeds and in a kilogram of wheat the number of these seeds may be as high as 6,600.

Boreava orientalis has infested the central part of Turkey. One yellow weed produces 10,000 seeds and in 1 sq. metre 100–350 plants were counted.

Cephalaria is easily controlled by hormone weedkillers such as 2,4–D, MCPA or MCPB at normal dosages. *Boreava* has proved to be resistant and a volatile ester of 2,4–D must be applied as the leaves of this plant are waxy.

Experiments on Chemical Control of Cereal Rusts *by F. R. Forsyth, Winnipeg (Canada)*

Since 1952, many protective type fungicides have been tested at Winnipeg including sulphur dusts and sprays, the carbamates nabam, ferbam, maneb and zineb, the naphtho-quinone Phygon XL and the crotonate Karathane. In addition several fungicides including actidione, calcium sulphamate and others, have been tested.

Zineb (65%) wettable powder has been found to be a very successful protective fungicide against stem rust and leaf rust of wheat in greenhouse and field tests. Since the 19% formulation of nabam, when combined with zinc sulphate, was found to be a lower cost fungicide than the zineb wettable powder, it was used in the recent field tests.

It was extremely important to apply the protective chemicals early, on the first sign of the presence of cereal rust. The profit per acre attributable to the effect of the fungicide has been found to be almost as great from two early, as from three, four or five sprays. Economical control of stem rust and leaf rust can be obtained with the best protective type of fungicide provided that weather conditions do not become adverse during the spraying programme.

An Improved Technique for 'Cold Testing' Maize Seed *by P. E. Hoppe, Madison, Wis. (U.S.A.)*

An improved rolled-towel technique for 'cold testing' maize seed is described. In this method the seed is incubated usually for 10 days at 10°C., in contact with a thin layer of muck soil naturally infested with seed rotting fungi, rolled in moistened paper towels – 'dolls'. This rolled towel technique should serve for studies with most crops that are subject to seed rot during germination.

1. Inbred lines of corn used in the Wisconsin corn breeding programme were tested for relative resistance to seed rot and seedling disease. Germinations in the cold tests ranged from 0% to 75% for the various inbreds. Most of the lines were found to be susceptible.

2. The technique was found particularly suited for evaluating fungicides for maize seed treatment. Using kernels from which the pericarp over the crown has been removed with a knife and exposing the starch tissue underneath, germination of non-treated controls usually was zero, whereas that for seed adequately treated with the better fungicides frequently reached 100%. Captan (Orthocide), thiram (Arasan) and B–1843 (an experimental) were among the most effective fungicides tested while chloronil (Spergon) was relatively ineffective and the antibiotic, oligomycin, afforded very little control.

3. A study of the effectiveness of maize seed treatment with fungicides by seed producers was made by comparing the cold test germination of the seed as it was treated by the producers, with the seed from the same samples after adequate re-treatment with thiram.

4. The method was used for detecting reduced germination in certain lots of old or carry-over seed which was not revealed in standard germination tests. Deterioration of seed quality increased with age.

The Development of Sodium Monochloroacetate as a Selective Weedkiller in Arable Crops *by T. C. Breese, Fernhurst, Surrey (U.K.)*

Solutions of monochloroacetate acid and its triethanolamine salt have been known as plant desiccants and defoliants in the U.S.A. for a number of years. The selective herbicidal properties of these compounds in vegetable crops and sweet corn have also been demonstrated in the U.S.A.

The author describes the development in the U.K. of sodium monochloroacetate (SMCA) in solution as a selective herbicide. The selectivity of SMCA was first observed in the U.K. when volunteer mustard growing in a crop of kale was destroyed but the crop was undamaged. Further testing led to the discovery that *Galium aparine* growing in cereals could be killed without serious damage to the crop.

Widespread trials in the U.K. in 1956 confirmed that *Galium aparine* and a number of other important weeds, which are resistant or moderately resistant to the growth regulator type herbicides, can be controlled with SMCA at rates which are safe to winter and spring wheat and winter barley. Low-volume applications proved more effective than high-volume application. Relatively non-toxic to mammals and easily soluble in water, the use of SMCA represents a considerable advance over DNC.

Effects of Diazinon, Salicylic Acid and Benzoic Acid on Wheat Nematode *by A. S. Srivastava and K. P. Katiyar, Kanpur (India)*

The wheat nematode, *Anguina tritici*, is a serious pest of wheat and infection results in a considerable reduction in yield. This nematode is mostly found affecting wheat in the western districts of Uttar Pradesh. DD fumigant has been recommended for control but in order to find a cheaper insecticide a number of compounds, which possess insecticidal properties, have been examined, viz. parathion, malathion, BHC, DDT, diazinon, salicylic acid, benzoic acid, and others in various concentrations. It has been found that of these, three compounds, viz. diazinon, salicylic acid and benzoic acid show specific toxicity.

GRAIN DRYING

T. J. RIVERS, A.M.I.B.A.E.
(Penney & Porter Ltd.)

With the ever-increasing use of combine-harvesters, and because of climatic and other considerations, grain drying is now an essential operation.

Half a million tons of new Kansas wheat being dried in a silo by means of air ducts on the floor

THE Romans in their early colonising of Britain in the 1st century A.D. built a form of grain drier, which was simply a storage chamber through which warm air from a wood fire circulated. Obviously then, grain drying has not become necessary merely because of the advent of the combine-harvester.

Before considering methods and the reasons for grain drying, it is interesting to see how the problem has hitherto been tackled in various countries.

In Canada and the U.S.A., the farmer shipped his grain straight from the combine in large grain wagons on the railways, and it was dried later in the elevators or silos of the mills. Largely because of fairly stable weather conditions at harvest time, the use of driers was not an urgent problem for the farmer. Moisture extraction was carried out only for storage or for shipment overseas, since grain with the moisture content reduced to 14% or under will not absorb much atmospheric moisture.

In Europe, where the climate is not so favourable, and in tropical regions where the humidity is high, the occasions when the harvest can be gathered without any need for drying are few and far between. It naturally follows that grain drying installations are really necessary.

Rice too, as the staple diet of many Asian countries with growing populations, needs to be stored and handled as efficiently as possible. The age-old methods of drying are inadequate and result in a high percentage of spoilage. The modern drier is the answer.

In Israel, several modern tower-type driers have been installed for the drying of maize, which is now being grown there in increasing quantities under irrigation. Maize is also dried extensively, but for a quite different reason, in Ghana, Sudan and Tanganyika. In these countries the people produce sufficient maize to meet their requirements, but their storage facilities are so primitive that weevil infestation rapidly reduces the stocks until it becomes necessary to buy more from other areas. To prevent this, large drying and storage centres have been established where maize is dried at 200°F (93.3°C). This not only kills the actual weevil (which can be accomplished with a temperature of 180°F (82°C)) but it also destroys the larvæ and eggs. The grain thereafter is stored in sacks, with regular inspection subsequently.

Although grain drying was practised long before the advent of the combine-harvester, its introduction has certainly led to the rapid development of drying equipment during the last 20 years. Today, particularly in England, the number of combine-harvesters now in service far outstrips the capacity, not only of the installations of the merchants and at the Government centres, but also of farm driers. This state of affairs is found in all countries where the combine-harvester has been introduced, and it is therefore imperative that combine and drier operations should be properly co-ordinated in the first instance.

Theoretical considerations

The reasons for grain drying, whether by natural or by mechanical methods, are the same. Grain is a living organism, and as such it gives off heat, water and carbon dioxide. If the moisture content of the grain is at all high, the respiration rate increases, with a consequent rise in temperature and gradual deterioration of the grain. This deterioration results from the action of the fungi and bacteria present in the grain, which flourish under damp and warm conditions.

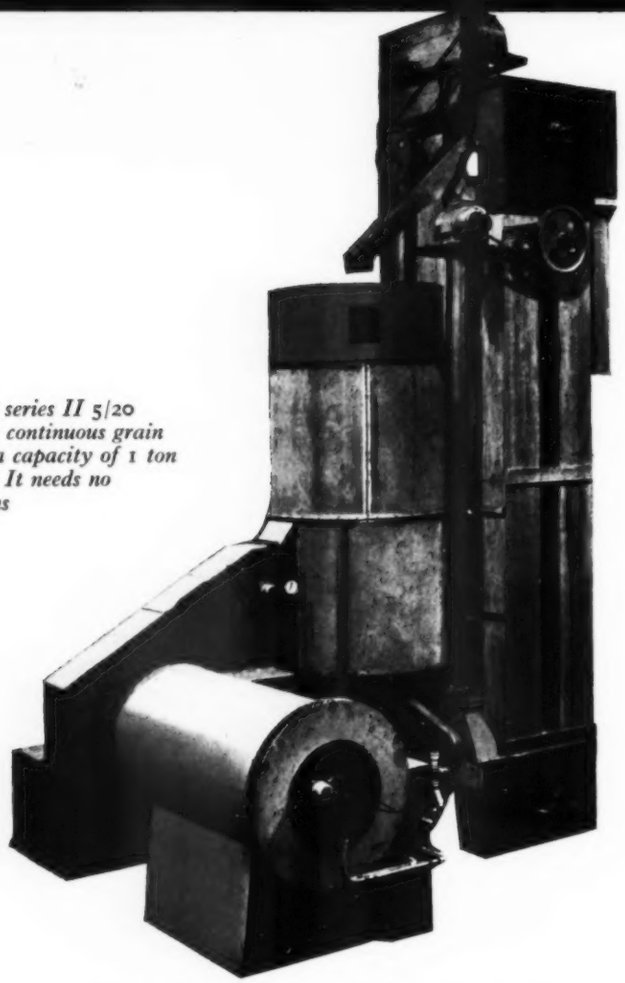
Under dry conditions, the majority of cereals can be stored in bulk with a moisture content of 12% to 14% for periods of up to 18 months. If stored in sacks, 15% is permissible up to five to six months. In countries with relative air humidity of under 63%, the moisture content of the grain would be about 14%, and thus the need for drying is very much less than where the relative humidity is, say, 85% or more. Here the moisture content would rise to approximately 19%, and 1 cu. ft. of air of this humidity contains five grains of water. A further important consideration is the wide variation in relative air humidity between day and night.

It is apparent from the foregoing that the increasing scarcity and high cost of labour will necessitate a careful consideration of requirements in the way of drying equipment for use in conjunction with the combine-harvesters of the farmer.

Basically there are two main types: static and continuous.

Static drying

There are several methods. As already mentioned, the Romans used it and the nearest modern version is probably the 'in-bin' system, often referred to as ventilated bins. The grain is placed in bins, having perforated metal or tile floors. The air, which is heated to 10°F above atmospheric temperature, but not exceeding 80°F (29°C), is blown at a minimum rate of 15 ft. per minute through the grain. The larger and deeper the bin, the larger the fan and the heater



The latest series II 5/20 ' Lincoln ' continuous grain drier has a capacity of 1 ton per hour. It needs no foundations

unit need to be; furthermore, grain containing over 20% moisture must not be placed in the bins at a depth of more than 8–10 ft.

An extraction of approximately ½% to 1% of moisture every 24 hours is normally obtained. The lower portions of the contents of the bins are of course dried first; the moisture passes upwards, and condenses on the cool upper layers. With grain in excess of 20% moisture, there is then a tendency for warm air to take the line of least resistance, by-passing these cold, wet patches. This can of course be overcome by transferring the grain from one bin to another.

Another static method is the ' in-sack ' process, in which the grain is dried in sacks of light hessian material. The sacks are laid upon grills and the air is blown up through the sack. Turning of the sacks is recommended after so many hours. With this system 1% of moisture can be removed per hour. Otherwise expressed, with a ' 20 hole ' unit 20 1-cwt. sacks will lose 5% of moisture in every 5 hours.

In the last two years another form of sack drying has been introduced. In this the sacks stand vertically, a ' spear ' of perforated metal is inserted into the sack and hot air is blown through the grain, the air being heated by electricity or by oil-burner.

Batch drying is another form of static drying; here the grain is placed on a tray or into a small bin with a perforated base, holding only one or two tons. Drying is at the rate of 5% per hour. When the grain is dry the container is emptied and refilled, the procedure then being repeated for successive small batches.

Continuous drying

With this system higher temperatures may safely be used, as the grain is always on the move, passing through the drier at a pre-determined rate. Not only is the grain moving down or along the drier, but it is continually mixing and turning over; thus the flow of hot air impinges upon all surfaces of the grain, and there is no danger of overdrying the grain nearest the heat source or hot air duct, entering the drying chamber or tray.

With the continuous flow drier a uniformity and equilibrium of moisture content is thus more positively achieved.

Large farms have found such driers to be indispensable, in view of the large quantity of grain to be dried, swiftly and effectively, for safe storage.

In one type of continuous drier the grain, after pre-cleaning, is passed up a belt and bucket elevator into a circular tower. This is made up of two concentric cylinders of perforated metal down between which the grain flows. This ensures an even thickness of grain during the process of drying.

Hot air is blown into the centre of the tower and its only way of escape is through the perforated walls between which the grain is flowing. A third of the way from the bottom of the tower the hot air chamber gives way to a cold air section, and cooling air is blown through the grain restoring its temperature to within 8°–10°F of atmospheric. From the tower, the grain is discharged through an elevator for bagging-off or by conveyors to storage bins.

Heating can be by oil firing, which has the advantage of simplicity, since a thermostat can be fitted and set to the temperature desired in accordance with the ultimate use to which it is intended to put the grain, *viz:*

100–110°F (37.43°C)—For malting or seed grain and for rice.
150°F (65°C)—For milling wheat.
180°F (82°C)—For animal feeding stuffs and weevil-infested grain.
200°F (94°C)—For weevil larvae and egg destruction in maize.

When drying rice, temperature fluctuations must be avoided, since sudden changes in temperature will cause the rice grains to split.

Where oil is expensive, or for instance in Scandinavian countries, where wood burning is encouraged by subsidies, solid fuel furnaces can be fitted for use with coke, wood, husk or anthracite. Electricity is used on smaller models, but the current load for driers working at above 1 ton per hour is high.

The power requirements of these continuous driers are low, since the increasing use of high-performance fans has reduced motor sizes by anything up to 40% as compared with those in the older types of grain drier.

Requirements

In assessing the requirements of individual farms or centres, it is necessary to consider the products to be handled. It should be remembered too that the drier can be working when the combine is idle because of inclement weather or heavy dews.

Some manufacturers state that their driers will dry so many tons per hour at 5 or 6%, but if no mention of the temperature or the original moisture content of the grain is made, this can be misleading. For instance, a drier will do 2 tons per hour at 150°F (65°C) when drying wheat from 21%–16% for milling purposes, but put that same unit on malting barley at 110°F (43°C) drying from 18%–13% (still 5% extraction) and output will be reduced by approximately 60%.

This same drier, operating at 180°F and drying from 22%–16% (*i.e.* 6% extraction) will show an increase in performance of up to 30%, since it is obviously easier to remove a higher moisture content as it is largely surface moisture.

Having decided on the type and size of installation required, consideration must be given to the siting and lay-out. Obviously it is necessary to arrange for the intake pits and the off-loading bays for both incoming and outgoing traffic to be accessible from hard roads and, if possible, a railway siding.

The wet grain receiving pits cannot be too large, the point being that should there be any hold up in drying or should the combine output result in grain coming in at a faster rate than the drier can work, the trailers arriving from the fields need not be held up because the pits are full.

Should it not be possible to have large pits owing to a high water-table, it may be possible to have a small pit with a high speed-elevator, discharging into pre-storage bins, erected above ground level.

Although in many parts of the world grain is still handled in sacks, bulk handling has come to stay and will, of course, increase with the increasing use of tanker-combines.

It will be well, therefore, when planning the layout of a drying plant, to make provision for the inclusion at once or at a later date of a bulk-loading bin.

Bearing in mind the capital cost involved in any installation, irrespective of size, it appears to be only common-sense to make full use of the advice of manufacturers. Any reputable manufacturer of grain drying equipment will provide specimen layouts which can be adapted to meet individual requirements.

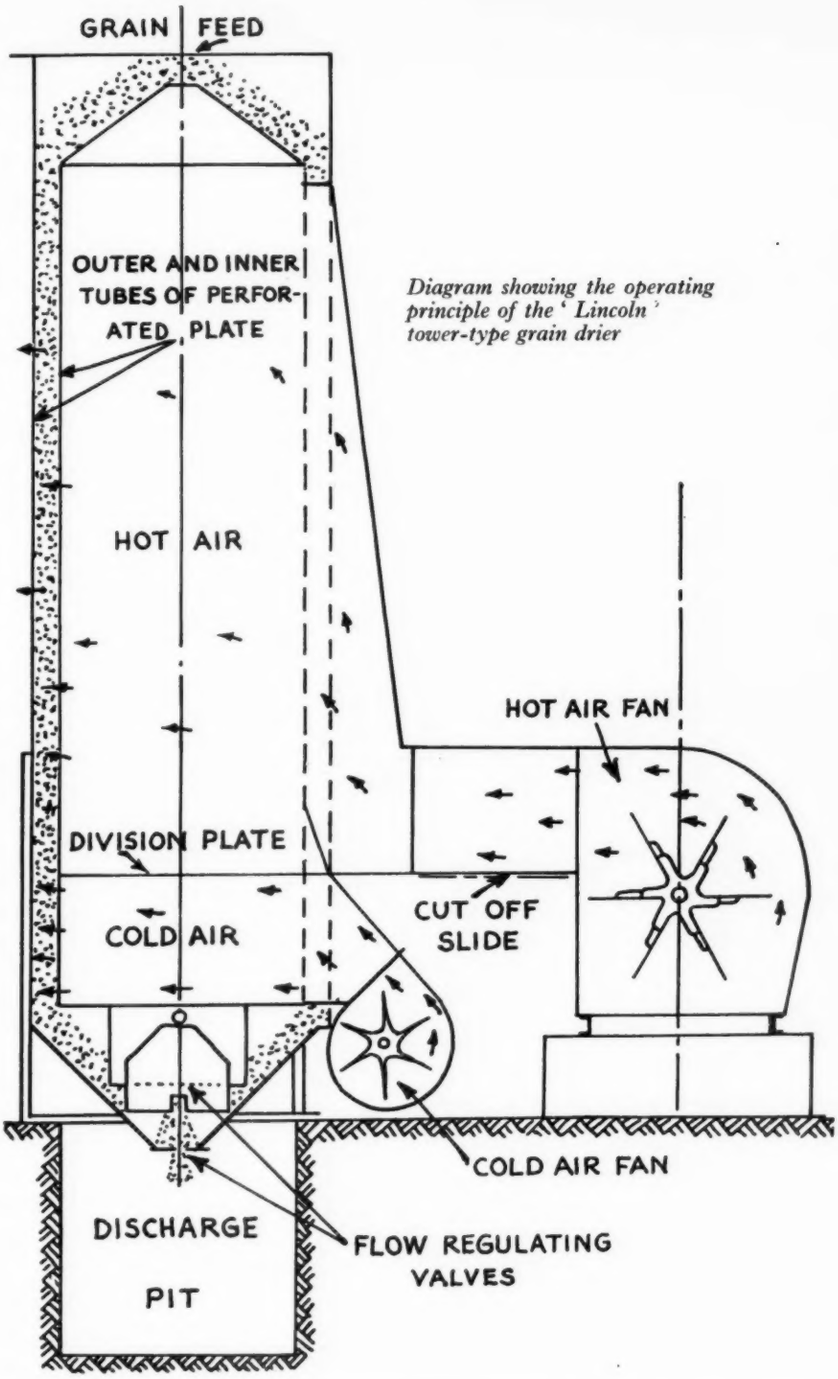


Diagram showing the operating principle of the 'Lincoln' tower-type grain drier

Cereal Seed Testing in U.K.

Farmers intending to use cereal seed of their own growing or yearling seed carried over from 1956 are advised by the British Ministry of Agriculture to have it tested first for germination; this is particularly important in the case of seed from the 1956 year's harvest in view of the difficult conditions of harvesting, due to heavy rains and floods in August and September 1956.

Samples for testing should be drawn so as to be representative of the whole bulk and should consist of not less than 4 oz. They should be sent to the Chief Officer, Official Seed Testing Station, Huntingdon Road, Cambridge, preferably in the standard type of packet which is obtainable from the Official Station. Samples should be accompanied by a remittance for the special fee of 2*s.* 6*d.* and a statement that the sender is a *bona fide* farmer and intends to sow the seed.

CHOICE OF SEED

The British National Institute of Agricultural Botany, which is the source of the information presented in this article, was founded in 1919 to promote the improvement of existing varieties of seeds, plants and crops, effect improvements in the treatment and processing of seed, and generally improve the methods of husbandry of economic crops.

THE frequency with which the question ' what seed shall I sow? ' is asked by farmers indicates the difficulty of giving a sound answer – an answer which obviously depends largely on the special conditions of each farm.

At the outset it is clear that a sample offered may be good seed and yet unsuitable for sowing at a particular place or at a particular time. Two points then need careful consideration: the suitability of the seed for the particular purpose in view, and the quality of the sample of that seed.

Variety or strain

Selection of the right variety or strain is of the greatest importance in all crops, and may well make the difference between profit or loss. The condition and type of soil, the climate, and the use to be made of the crop must all be considered in the choice of variety. Local custom frequently provides a ' safe ' choice, but in recent years many new varieties have been introduced in practically all crops and some of these have important advantages over the old-established varieties.

The fact that a variety is new does not, however, mean that it is always an improvement. Much valuable knowledge has been gained in recent years as the result of field trials by the National Institute of Agricultural Botany, by the National Agricultural Advisory Service, and by other research institutions. For many of the main agricultural crops the results of this work have been summarised in Farmers' Leaflets, published by the National Institute of Agricultural Botany. These describe the main characters of the chief varieties available. For the three main cereals, for potatoes and for sugar-beet, the leaflets incorporate lists of varieties ' recommended ' by the N.I.A.B. as the most suitable for growing in Britain. Records have shown that farmers who obtain the best financial returns have been growing ' recommended ' cereal varieties, and those who did not know the name of their varieties obtained the lowest returns.

In selecting a variety from those described in the leaflets each farmer must make a decision for himself, from his knowledge of the particular agricultural conditions of his farm, and of the use which he proposes to make of the crop. To guide him in his choice the leaflets give information on the main agricultural features of the crop and on the quality of the produce.

For most forage crops, clovers, grasses, lucernes etc. the work of testing strains has not yet reached a stage where it is possible to issue ' recommended ' lists. For such crops the farmer should enquire about the type of any new strain, whether for example it is early, mid-season or late in flowering, or for hay or pasture use. In some cases pedigree strains are available from British plant breeding stations. In others, the country or district of origin is of great importance, and may make all the difference between success and failure. To make sure of the origin of the seed is, in many cases, the only way to ensure a suitable strain. In such cases it is a sound general principle that the more similar the conditions in the country or region of origin are to the farm for which the seed is intended, the more likely is the strain to be successful.

Origin of seed

In a more parochial sense, the origin of seed may be of the greatest importance in all crops, for an unsatisfactory seed crop cannot produce satisfactory seed. In recent years British Field Approval and Seed Certification Schemes have been developed

The N.I.A.B. headquarters at Cambridge

by the Seed Production Committee of the National Institute of Agricultural Botany, so that the buyer of seed may have some assurance that it came from a satisfactory crop. Under these schemes, the seed crop is inspected for varietal purity, for weeds and seed-borne disease: under Certification Schemes there is also supervision of the seed from the growing crop to the sack that is offered for sale. Schemes are now in operation for the recommended varieties of cereals, the Aberystwyth and certain local strains of herbage crops, the varieties of vegetables bred by the National Vegetable Research Station, and hybrid tomatoes bred by the John Innes Institution. For such crops the purchase of field approved or certified seed implies a high standard of quality.

These schemes do not as yet cover all crops, nor all varieties a farmer may wish to grow. Varieties and strains of root and vegetable crops are particularly liable to show variation from year to year and from one merchant or grower to another. The greatest care should therefore be taken to secure seed of these crops from highly reputable sources.

Price

When buying seed, price should never be the first consideration. To sow poor seed merely because it is low-priced is 'penny wise, pound foolish'. It is equally foolish to buy seed merely because it is high priced, and this is particularly true when the high price refers to a new variety the value of which has not yet been proved in properly conducted trials.

Quality

Having chosen the variety, and source of seed, the farmer will wish to consider the quality of the sample as seed. In this the important factors are its purity, its germination, and its freedom from seed-borne disease. Both purity and germination are covered by the Seeds Act, 1920, and the farmer should see that the declaration to which he is entitled is satisfactory before deciding to purchase. For a farmer who has grown his own seed, the Official Seed Testing Station at Cambridge will provide the necessary information for a nominal fee, provided it is sent with the sample and accompanied by a declaration that the seed will be sown by the farmer himself.

Two unsatisfactory plots in trials of foreign cocksfoot strains at Cambridge. One strain failed to survive the winter, leaving an empty plot. The other contained widely differing plants in the same row plant

Purity

Complete purity is rarely obtainable, and seed is no exception in this respect. The farmer needs to take note of the type of impurities present as well as of the quantity. The chief among them are:

Weed seeds. Strictly, any plant out of place is a weed, but the term is used here for seeds of plants which will interfere with normal cultivations, or the growth of the crop.

Five of the worst types of weeds have been scheduled in the Seeds Act, 1920, as injurious weeds, and seed containing more than 5% by weight of these may not be sown or offered for sale. These weeds are docks and sorrels, *Rumex* spp.; cranesbills, *Geranium* spp.; wild carrot, *Daucus carota;* Yorkshire fog, *Holcus lanatus;* soft brome grass, *Bromus mollis* et spp.

Other weeds may be nearly as harmful, and it is worth remembering, for instance, that 1%, by weight of ribgrass in a sample of red clover may mean several seeds *per square yard.* Clean seed is therefore worth an extra price to every farmer. If absolutely clean seed is not obtainable then care should be taken to avoid introducing new kinds of weeds to the farm.

Among cereals the following weeds are particularly troublesome on account of the difficulty of removing them, and also of the vigorous growth of the resulting weed plant at the expense of the cereal crop: wild onion, *Allium vineale,* as bulbils in wheat; wild radish, *Raphanus raphanistrum,* in barley; wild oats, *Avena fatua,* or *ludoviciana;* Shepherd's needle, *Scandix pectenveneris,* in oats or barley.

These weeds may seriously affect the quality and value of the commercial grain produced from seed: wild onion for example causes a serious taint in flour. Also troublesome are cleavers (*Galium aparine*) and wild tare (*Vicia* spp.), which encourage lodging.

With the larger seeds such as peas and beans, cleaning is a fairly simple operation and weed seeds are not normally present in any quantity. With small seeds, such as clovers and grasses, cleaning is more difficult, and weeds are therefore more commonly present in commercial samples. Seeds which have been dressed through a modern seed-cleaning plant are usually more free from harmful impurities than those dressed only over a winnowing machine on the farm. It is therefore strongly recommended that seed intended for the production of further seed crops should be dressed through an efficient seed-cleaning plant.

Other crop seeds may be present in the sample, and are recorded as useful species in the seed testing purity report. Whether or not these particular seeds are harmful depends upon the intended use of the crop. A small proportion of lucerne in a clover crop intended for hay or silage is of little importance, but even a little wheat in a barley crop intended for malting may seriously reduce its value.

Inert matter is also specified in the purity report and is usually chaff, dirt, or broken seed. It is of importance to the farmer in that it increases the cost of the good seed in the sample, but it does little harm unless it carries disease.

Germination

Healthy, well-harvested seed usually germinates rapidly and uniformly. When the Official Seed Testing Station is testing seeds which normally take some time to germinate, interim reports are issued so that the interim germination, as well as the final percentage of germination, is available. If the final percentage of germination is low, it may be possible to obtain a crop by increasing the seed rate.

Cereal seed, which is in good condition, and contains less than 15% of moisture, may be stored without loss of germination for many weeks in a dry place even after it has been treated with an organo-mercurial compound. On the other hand, cereal seed containing over 16–17% of moisture is liable to deteriorate during storage, particularly if it has been treated with a seed dressing. For other crops lower moisture contents are necessary for safe storage.

Disease

Seed-borne diseases are of two kinds, those within the living seed itself, and those merely carried on the outside. Some of the latter can now be controlled by means of modern seed dressings, such as the organo-mercurials, and every bag of cereals intended for sowing should be dressed in this way. The presence of diseases, carried internally, such as loose smuts of wheat and barley, cannot be readily detected and these are not controlled by external seed dressings. The best safeguard is to choose seed grown from healthy crops, grown at a sufficient distance from diseased crops of the same cereal.

For certain seed-borne diseases, such as bunt in wheat, leaf spot or blight in celery, Ascochyta in peas, and blind seed disease in ryegrass, seed samples can be examined at official seed testing stations, such as that at Cambridge.

Other diseases, such as ergot, may be carried with the seed sample and are reported among the inert matter in the purity report from the seed testing station.

Summary

Before buying seed, a farmer will wish to consider the following points:

the variety or strain, to suit his local conditions and potential market;

the origin, to ensure trueness to variety;

the purity, or freedom from weeds or other harmful matter;

the germination as reported in the seed testing report, and the storage conditions since the test was made;

the freedom from seed-borne disease.

The price should only be considered if all the other factors are satisfactory.

Examining a clover seed sample for the presence of dodder, using a special inspection belt fitted with a magnifier

Coconuts in Seychelles

Mr. F. C. Cooke, editor of WORLD CROPS, will be leaving London on 8 April on a special mission to the Seychelles – a group of islands in the Indian Ocean – to advise the Government on the measures which should be taken to improve the coconut industry.

He expects to arrive in Bombay on 10 April and proceed to Mahe by S.S. ' Karanja ' on the day following. He will be visiting the various islands from 16 April to 2 May, when he will sail for Mombasa, Kenya, by the S.S. ' State of Bombay ' and will leave Nairobi by air on 9 May and so will be back in London in time for the opening of the *Pest Control Exhibition* on 12 May.

Canadian Wheat

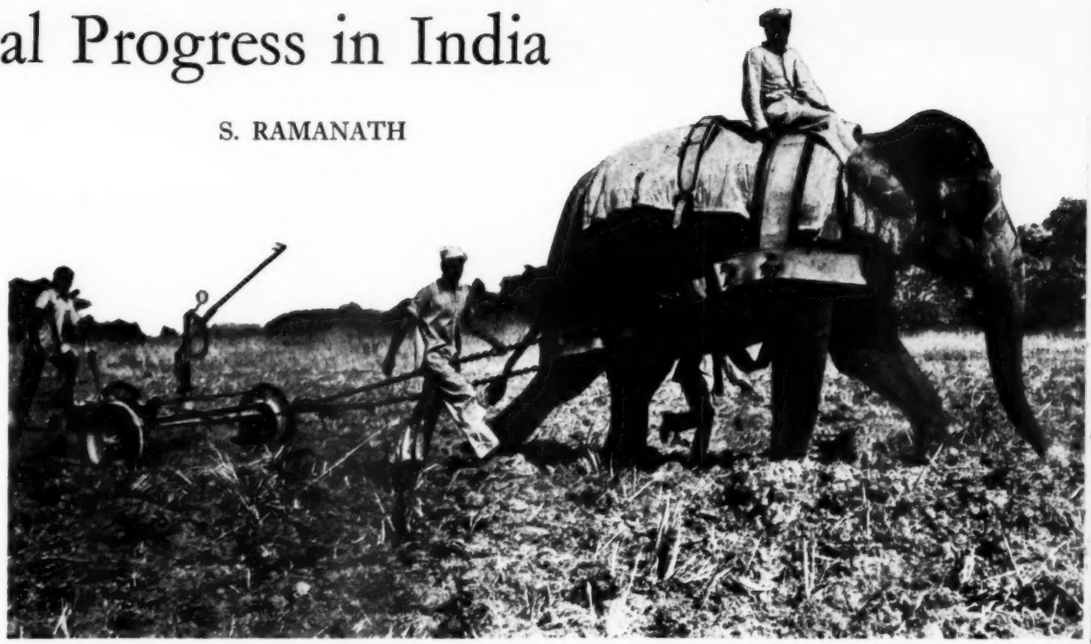
Film produced by the National Film Board of Canada. 16 mm. Colour or black and white, sound. Running time: 25 min.

Vast fields of ripe wheat are seen being harvested by great combine-harvesters and the film then follows the progress of the grain until it is milled into flour, showing how wheat is weighed, tested and examined to determine its grade and quality, and how chemical tests are applied to determine its milling and baking qualities. Research aimed at breeding hardier, more resistant varieties and the fight against insect pests, parasites and fungus are also described.

Agricultural Progress in India

S. RAMANATH

India is agriculturally the most backward of the large countries of the world. Nevertheless, here is an encouraging report on the progress that has been made since the start of the First Five-Year Plan.



THE success of the First Five-Year Plan is evident from the figures given in Table 1, which show to what extent the target was exceeded, with the single exception of rice. This achievement was the greater as the five-year period came after a series of major economic dislocations caused by the war, the partition of the country, and also floods.

Contributing factors

The increase in food production during the years since 1949 has been largely brought about by the provision of irrigation, land reclamation schemes, increased use of fertilisers, distribution of improved seeds and mechanised cultivation. The Central Tractor Organisation has done remarkable work during the last seven years in extending the cultivated area. It has reclaimed over 1.2 million acres of Kans-infested land in Central India and about 41,000 acres of jungle land in Uttar Pradesh and another 4,800 acres in Bhopal. Even elephants were used for ploughing and harrowing. In Uttar Pradesh, where such experiments were conducted, it was estimated that a bull elephant could plough 7½ acres a day at a cost per acre of Rs 3/4/- and a working cost per day of Rs 24/6/-. The corresponding figures for tractor-ploughing were about 12 acres at Rs 5/- per acre or Rs 60/- per day. The elephant can exert an approximate equivalent of 30 h.p. and should be suitable for moderate size farms of up to 100 acres.

Japanese methods

The campaign for the introduction of the Japanese method of paddy cultivation has been highly successful. The spectacular overall increase in production of paddy by this method has established the efficiency and utility of certain fundamentals, such as proper tillage of the seed-beds and lands; low seed rate, use of improved and properly treated seed; sowing of crop in line with optimum spacings; use of irrigation; weeding and hoeing at intervals: control of pests and diseases and judicious use of both organic and inorganic manures. As a result of the Japanese paddy campaign which now covers about 1.6 million acres, a scheme was launched in 1954–55 to extend this method to other crops, particularly sugar-cane. The results of this campaign were very encouraging, and the scheme has been extended to cover a wide area of 7.69 lakh* acres. The resulting increase in yield is estimated at nearly 30%, or over five tons of additional sugar-cane per acre.

*lakh = 100,000

Second Five-Year Plan

During the Second Five-Year Plan the target of food production has been fixed at 80.5 million tons (original target of 75 million tons has since been revised) as against 65 million tons produced at the end of the First Plan.

These new targets represent an overall increase of 27% – as against 17% originally contemplated – and their realisation would mean an increase of 15.5 million tons in foodgrain production.

As in the First Plan, higher production is to be achieved largely through improved techniques and intensive methods of cultivation. The Second Plan aims at a diversified agricultural economy as it includes development of livestock. The total irrigated area is expected to be increased to about 90 million acres as a result of the completion of some of the major irrigation projects and other minor irrigation works. This coupled with the use of fertilisers will help to increase food production considerably, since the present low yields are, to a very large extent, due to the neglect of

Table 1
Food production (in million tons)

	1949-50	1955-56	*First Five-Year Plan target*
Rice	23.2	25.5	27.2
Wheat	6.3	8.5	8.3
Other cereals	16.5	21.0	17.0
Grains and pulses	8.0	10.0	9.0
Total foodgrains	54.0	65.0	61.5

Tractors of the Central Tractor Organisation engaged in a tree-felling operation in Uttar Pradesh

Table 2
Food targets in Second Five-Year Plan

	1955-56	1960-61 (*revised target*)
Foodgrains	65.0 million tons	80.5 million tons
Oil seeds	5.5 ,, ,,	7.6 ,, ,,
Sugar-cane	5.8 ,, ,,	7.8 ,, ,,
Cotton	4.2 million bales	6.5 million bales
Jute	4.0 ,, ,,	5.5 ,, ,,
Tea	644 million lb.	700 million lb.

the fertility of the soil. It is proposed to increase the rate of consumption of nitrogenous fertilisers from 6 lakh tons to 18 lakh tons. Special attention will be given to green manuring practices and the utilisation of sewage, compost and other manures. A comprehensive seed multiplication and distribution scheme has been drawn up by which one seed farm of 25 acres will be located in each development block. By the end of the Second Five-Year Plan it is expected that more than 4,280 such farms will have come into existence. It is proposed to increase the area under the Japanese method of paddy cultivation from two million acres in 1955–56 to eight million acres by the end of 1960–61, the additional production being estimated at two million tons of rice.

There are also bold schemes for reclamation of land and soil conservation. It is proposed to reclaim 1.5 million acres of land and to carry out land improvement measures over an area of two million acres. Soil conservation measures to be applied to over three million acres of land are expected to bring into cultivation large areas, at present affected by erosion.

Mixed agriculture

Much emphasis has been placed in the Second Five-Year Plan on the development of a diversified agricultural economy by the simultaneous introduction of its different branches such as animal husbandry, dairying, forestry, fisheries and development of co-operative societies.

Although India's cattle population is enormous, the amount of milk available for consumption is comparatively small. The new plan aims at a 30% to 40% increase in milk output in 10 to 12 years, but in the immediate future it is proposed to improve the supply in urban areas by establishing cattle colonies, dairies and co-operative milk unions. The plan aims at the establishment of 36 urban milk supply schemes, 12 co-operative creameries and seven milk-drying plants.

Poultry development schemes, which make for improved nutritional standards and the introduction of mixed farming, require the organisation of four regional farms and 300 extension centres. A programme for the development of inland and marine fisheries provides for the survey and charting of fishing grounds, development of fishery research and training, supply of fishing requisites and seed, improvement of fishing methods, provision of fishing harbours and the organisation of transport, storage, marketing and processing of fish.

An integrated programme of co-operative development covering all important aspects of economic activities, *viz.* credit, marketing, processing and storage has also been formulated. The target for short-term, medium- and long-term credit has been fixed at Rs. 150/- crores,* Rs. 50/- crores and Rs. 25/- crores respectively, as against Rs. 30/- crores, Rs. 10/- crores and Rs. 3/- crores fixed in the First Plan.

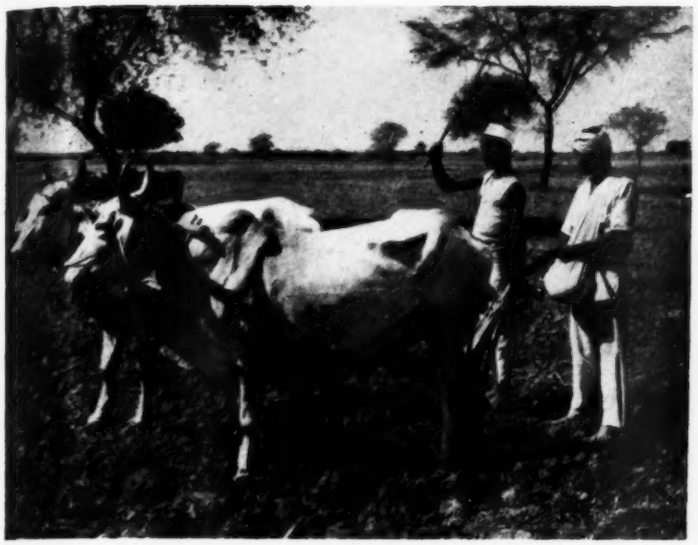
Japanese method of rice cultivation. When transplanting, the seedlings are pulled out one at a time without injuring the roots

(Right) *A good paddy crop raised by Japanese methods of cultivation*

Training

Another important feature of the Second Plan is the significance attached to the National Extension

*crore = ten millions or 100 lakhs.



Ploughing in the traditional way with a pair of bullocks

Service and Community Development programmes for popularising improved techniques of agricultural production. In a development programme of this magnitude, the importance of having well-trained personnel, of research along proper lines and of making the fruits of research available to the cultivator cannot be exaggerated.

The Government of India is providing financial assistance to state governments to set up new agricultural and veterinary colleges and to provide increased and better facilities for teaching in some of the existing colleges. The requirement of agricultural graduates during the Second Plan period is estimated at 6,500 and on the veterinary side at 5,000. Steps have been taken to secure such equipment as would enable these colleges to maintain well-equipped laboratories, farms and libraries. But measures to strengthen agricultural education at the college level will not completely satisfy India's pressing need for an enlightened farm community. In India, as in other countries, not more than a small percentage of the graduates of agricultural colleges go back to the farm. The problem, therefore, is to secure a large number of young men who will be ready to return to the farm after a period of training in scientific techniques so that they may not only adopt scientific farming as a vocation but also interest their more conservative neighbours in such improved practices.

India was a net importer of foodgrains before the second world war and the deficit was about 5 to 7% of the total production at the beginning of the First Five-Year Plan. The country has largely overcome this handicap and the increase in production now envisaged is to meet the increasing food requirements of a growing population.

Grain Drying and Storage

Wheat which is overheated in drying may be useless to flour millers since the gluten may become denatured. Overheating will also impair germination and make barley unsuitable for brewing and any grain unsuitable for seed.

Losses of grain due to faulty drying and storage can be avoided by the observance of the following five rules, which are given by the British Ministry of Agriculture.

1. Grain which is to be dried and stored should be as free from damage as possible. Avoid 'combining' grain when it is too wet, or with excessive cylinder speed, or with close concave setting of the drum.

2. Grain for drying should be cleaned before drying is commenced. The inclusion of green matter can spoil the performance of a drier and thus cause damage to the grain.

3. Overheating should be avoided. This can be achieved by careful observation of the manufacturers' instructions for using the driers. In no circumstances should very wet grain be dried quickly. As a general principle, the wetter the grain, the lower is the rate at which it is safe to extract moisture. Grain dried from a high moisture content and stored in bulk should be turned at least once soon after drying.

4. It is important to ensure that grain for storage is dried evenly to a safe level of moisture content. Full use should be made of the various moisture meters that are available. If properly used, these are sufficiently accurate for practical purposes throughout the range of moistures at which grain should be harvested. Even drying is essential because any pockets of damp grain are likely to heat and spoil the whole parcel.

5. Grain should be cooled after drying and its temperature in store kept as low as possible.

Experience has shown that at the maximum levels of moisture content indicated in the left-hand column below, grain should not be stored for longer than the periods stated in the right-hand column.

Maximum moisture content	*Maximum storage period*
14%	Wheat, barley and oats (in bulk or in sacks) – 18 months.
15%	Wheat and oats (in bulk) – 12 months. Barley (in sacks) – 6 months.
16%	Wheat and oats (in sacks) – 6 months.
Over 16% and up to 18%	Wheat and oats (in sacks) for early despatch.
	Dirty samples may heat within two weeks.
Over 18%	Rapid heating and moulding are to be expected in all grains, particularly if dirty or damaged.

Winning Wheat

British seed growers and merchants figured prominently among the prize-winners at the Royal Agricultural Winter Fair, held at Toronto, Canada. The world championship for wheat was won by Mr. A. Davidson of Dengewell Hall, Wix, Manningtree, Essex, with a sample of 'Cappelle Desprez', a soft wheat, entered in association with Brooks (Mistley) Ltd., Mistley, Manningtree, Essex.

Electronics in Agriculture

The process of cleaning grain uses a variety of techniques, including sieves and vibration, pin machines and brushes, forced draught and suction, gravity, magnetism, and so on. One serious type of problem, however, has remained, the problem arising from the discoloration of part or all of a single grain. An additional problem of a related kind is the separation of different varieties of seed where the sole difference lay in colour or even shades of the same colour. This can now be effectively done by an interesting new machine – the ' Sortex ' electronic separator.

Operating principle

The machine operates on a principle which is absolutely new in the field of grain or seed cleaning, in that the unwanted seeds receive an electric charge and while still holding this charge are, through electronic action, extracted from the bulk. The charge is practically instantaneous and is almost at the same moment lost without the slightest after-effect on the seed.

The product to be sorted is fed from the hopper (1) by means of a vibrating chute (2). The seeds align themselves on the grooved belt (3) by which they are projected in single file to the place of even illumination (4) and inspection by two photocells (5) from approximately opposite sides.

Any seeds which are stained or have a colour so as to appear different from the backgrounds (6) will receive a charge by corona discharge from the point (7).

The seeds continue along their normal trajectory into the electrostatic field created by deflectors (8) and (9) and thus the seeds which are charged will be drawn out of the normal stream to the other side of a dividing edge (10) for separate collection. It will thus be seen that separation is automatic and occurs in mid-air, without any mechanical aid whatsoever.

Seed cleaning

In addition to being able to sort a great variety of commodities, special attention has been given to the grading of cereals:

Rice – the separation of coloured grains from decorticated rice

Gunson's electronic sorting machine. Here the funnel is on the left and delivery on the right. The schematic diagram below, illustrating the method of separation by colour in an electro-static field, is in reverse

Ergot – the separation of ergot from wheat and rye for pharmaceutical purposes

Wheat – the separation of red from white wheat for seed purposes

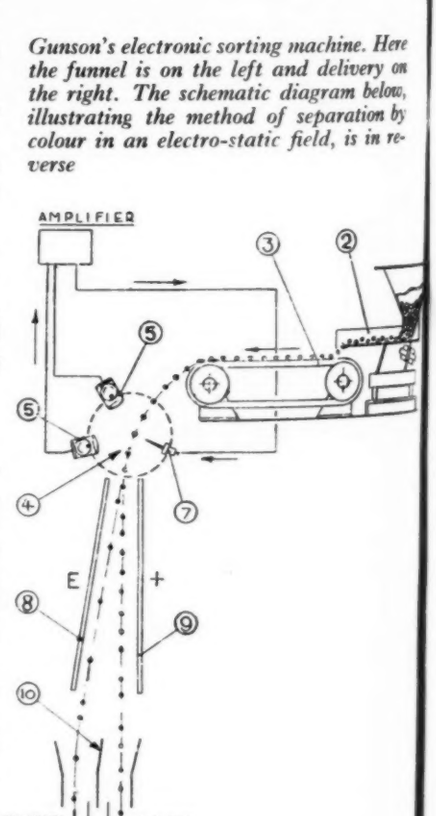
Oats – the separation of black from white oats for seed purposes

Maize – the separation of white maize from yellow and other colours

The greatest use to which the machine is being put at present is for cleaning decorticated rice and there are a number in use in America; in England and Germany, a number are being used for the separation of ergot.

Performance

On rice, the average throughput is in the region of 60 lb. per hour for a single machine. Each machine is self-contained and is so designed that any number can be arranged in bank formation to give any desired output rate. Thus a battery of 10 machines would give an output of some 130 cwt. of grain seed in a 24-hour day. For the separation of ergot from wheat, output is in the region of 80 lb. per hour. The machine has also been successfully used for the sorting of peas, beans, groundnuts, almonds and coffee.



NEW PUBLICATIONS

Grassland Seeds

By W. A. Wheeler and D. D. Hill. Pp. 752, illustrated. London: D. van Nostrand Company Ltd. 94*s*. or $12.50.

This sizeable volume is the fourth in the Grassland Farm Series, edited by the senior author. Other books in this series have dealt with grassland as part of the agricultural economy in the U.S.A., not only in the production of forage but also in relation to soil conservation. This latest addition is intended as a reference book for all those who are concerned in any phase of production and distribution of grassland seeds and covers all aspects very comprehensively. The authors have had the assistance of leading authorities throughout the U.S.A.

The book is divided into three parts, of which the first is general in nature. After stating a philosophy of grassland farming it deals with the botanical and biological aspects of seeds, including seed testing in the laboratory, and finally has several chapters covering seed production of herbage plants and the distribution of high-quality seed to the farmer through various organised channels. There is much information of an essentially practical nature which should be of value, both to seed growers and seed merchants. In particular the problems of cultivation, harvesting, seed cleaning and drying and the storage of field seeds are covered very fully. An account is also given of the foundation seed programme in the U.S.A. and its close link with certification of seed. The references to marketing apply, naturally, to a country which has a highly developed seed trade.

The second part deals with specific herbage crops and their particular seed problems. But in addition there are useful notes on individual varieties indicating their main agronomic characteristics and adaptation to different climatic conditions in the U.S.A.

Part III provides an appendix which includes statistics relating to supply and use of field seeds in U.S.A., specifications of screen sizes for cleaning different seeds, seed certification in U.S.A. and other information of more interest to the seed merchant in that country.

The object of the authors has been to produce a handbook of information on grass and legume seeds and in this they have succeeded admirably. Although intended primarily for American consumption, the book contains information which could equally well be applied elsewhere. In some instances the information is a little diffuse, but this is more than offset by a very complete index and a comprehensive list of references.

G. W. G. BRIGGS

The World of the Soil

By Sir E. John Russell. Pp. 237, illustrated. London: Collins. 1957. 25*s*.

One hallmark of greatness in a scientist is ability to impart information on his subject to the layman in terms which make its complexities seem simple. Sir John Russell, in his latest book – No. 35 in the New Naturalist series – shows how this should be done. Not only has he succeeded in welding into a fascinating story a subject with ramifications into many of the basic sciences, but has done so with the minimum use of technical terms. In addition, the frequent references in the book to recent scientific publications in the various fields of agricultural research bear testimony to the thoroughness with which the author has applied himself to his task.

The book, as its title proclaims, takes the reader inside the soil. The initial chapters deal briefly and adeptly with its physical and chemical composition. They provide a background for the following three chapters (about one-third of the book) which are devoted to the soil inhabitants. This is as it should be, for the soil is a dynamic system with, as Sir John puts it, ' numerous invisible crevices inhabited by prodigious numbers of living organisms '. The succeeding chapters will be of particular value to the practical man of the soil who is looking for sound principles on which to obtain the best from his land, while at the same time preserving his heritage. Next we are treated to an admirable discussion of the manner in which the various properties of the soil have influenced the natural features of the land. This is followed by a concise account of modern methods of soil survey and analysis. The book ends with a short chapter of special interest to the agricultural economist. For those readers who will be stimulated to pursue the various topics further, the author has provided a very useful bibliography. The book contains over 40 photographs (a few in colour) and they are all excellent. A few printers' errors occur here and there. Scottish readers would be puzzled by the spelling of the place names in the caption to Plate XXII and microbiologists would disagree too with the nomenclature used in the caption to Plate IV, but these are minor defects in a work of great stature.

D. M. WEBLEY

The Wealth of India

A Dictionary of Indian Raw Materials, Vol. IV (F-G). Pp. 287, illustrated. Council of Scientific and Industrial Research, New Delhi. 1956. Rs. 25 or 37*s*. 6*d*.

It is now ten years since the first volume in this series was received, but this long delay is partly to be explained by the encyclopædic nature of the production and the multiplicity of authors required to execute such an ambitious project. It is indeed a worthy successor to the earlier volumes; the subject matter and method of presentation are again excellent.

The present volume (F–G) includes 340 items, of which 325 relate to plant species; the index gives their names in the Indian languages and also, where possible, their common English names. The most important crop dealt with in this volume is cotton, *Gossypium* spp. (81 pages) and soya bean, *Glycine* spp. (9 pages). Other items of special interest are edible mushrooms, the wood apple, *Feronia limonia*, the mangosteen, *Garcinia mangostana*, and the fig, *Ficus carria*. The text is supported by 13 beautifully executed coloured plates and 145 photographs.

This monumental and invaluable production is one which needs to be completed within a reasonable period of time, and we would urge that the remaining six volumes should be published within the next two years, otherwise subscribers will lose interest and the production may fail. A possible solution of the difficulty would be to appoint an assistant editor for each of the remaining volumes and thus expedite matters.

F. C. COOKE

Phytochemistry

The late Dr. Eldin V. Lynn of the Massachusetts College of Pharmacy spent many years searching the literature for references to phytochemistry and the results of his work are being edited by two members of the College faculty. Monograph I of the Lynn Index, which deals with the order *Centrospermae*, is now available and consists of 46 pages. It is estimated that 70 or 80 issues will be needed to complete the project.

Each monograph will be concerned with species from a single plant family or from a group of related families and the contents will be so arranged that one can determine what work has been reported on a given plant and what constituents have been isolated and identified.

Monograph I is obtainable from the Massachusetts College of Pharmacy, Longwood Avenue, Boston, U.S.A., price $1.00.

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Fruit Annual, 1957-58

This is a comprehensive and well indexed manual of salient facts and figures relating to the world fruit industry.

A chapter on mechanisation in fruit growing, processing and packing is included, and a reference section on the processing and canning of fruits and nuts. The World Survey section gives details, information and figures of fruit crops, production, exports and imports of dried, canned and frozen fruits, edible nuts, tropical fruits etc.

Obtainable from British-Continental Trade Press Ltd., 222 Strand, London, W.C.2, price 20*s*.

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FAO Publications

Report of the Nutrition Committee for South and East Asia, Fourth Session, held in Japan from 25 September – 2 October, 1956. Among subjects considered were the beriberi problem, improving the nutritive value of rice and the study and prevention of protein malnutrition. Price 2*s*. 6*d*. or $0.50.

Hanunoo Agriculture in the Philippines. This detailed study by Dr. Conklin of the Department of Anthropology, Columbia University, New York, forms part of a general enquiry on shifting cultivation and follows two previous studies carried out in Africa. Price 10*s*. or $2.00.

Agricultural Commodities and the European Common Market. Bulletin No. 29 in the Commodity Series is a review of the probable effects of the Common Market Treaty and is arranged in sections under the various commodity headings. Price 1*s* 3*d*. or $0.25.

Programme for the 1960 World Census of Agriculture, as submitted to the FAO Conference at its Ninth Session in November 1957. Price 5*s*. or $1.00.

Select Bibliography on Co-operation. This list gives a brief summary of the contents of each publication, as well as the usual bibliographical particulars. Price 2*s*. 6*d*. or $0.50.

Food and Agricultural Legislation, 1957. Vol. VI, Nos. 1 and 2. No. 1 includes legislation on trade and feedstuffs and fertilisers in Austria, food laws in Ceylon and Italy and forest legislation in Switzerland. No. 2 includes legislation on the manufacture and sale of pesticides in Uruguay, land tenure and land reform in Viet Nam and Yugoslavia, and oil seeds and vegetable oils in Portugal.

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Copper as a Plant Nutrient

This paper by F. A. Gilbert of Battelle Memorial Institute, Columbus, Ohio, U.S.A., has been published in Vol. 1, No. 2, of *Agrochimica*, a journal issued under the auspices of the Instituto di Chimica Agraria of the University of Pisa, Italy. Experiments at the Battelle Institute showed that yield responses to copper may be obtained on soils with no apparent copper deficiency.

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Other Publications

We have received copies of the following publications:

Agricultural Weedkillers, an illustrated handbook on selective weedkillers for farm use by May & Baker Ltd.

Fifth Annual Report of the West African Institute for Oil Palm Research, obtainable from the Director of the Institute, near Benin City, Nigeria, price 2*s*. 6*d*. Further details of interesting experiments on different methods of combining palm planting with food crop cultivation are given in the Journal of the W.A.I.F.O.R., Vol. II, No. 7.

Report for 1956 of the Pea Growing Research Organisation Ltd., which includes a report on the dried pea seed approval scheme for improving the standard of seed stocks and an account of field experimental work carried out in 1956. Copies may be obtained from the Pea Research Station, Yaxley, Peterborough, free to subscribers; 2*s*. to non-subscribers.

Annual Report for 1956 of the Tocklai Experimental Station, published by the Indian Tea Association Scientific Department, which gives interesting accounts of experiments with insecticides, effects of artificial shading on soil and climatic environment etc.

Report of the Fifth International Conference on Muskrat Control, published by EPPO, price 2*s*., F. fr. 120. The conference discussed the serious spread of muskrat infestation in the region of the Saar, Federal Germany, France and Luxembourg and recommended intensive control campaigns, for which appreciable funds will have to be raised.

Technical News

Articles appearing in the March issue of some other journals of the Leonard Hill Technical Group include the following:

Dairy Engineering 'Current Development in Mechanised Cheese Manufacture' by Dr. W. G. Wearmouth, 'New Australian Method of Cheddaring Cheese' by J. Czulak, 'Czechoslovakian Developments in Cheese Manufacture' by Ing. Jiri Zapotocky.

Food Manufacture 'Problems and Perspectives in Malt Vinegar Brewing' by J. White PH.D., F.R.I.C., M.I.BIOL., 'Bulk Handling' by W. J. Farrand, B.SC.(ENG).

Bookshop Service

Books reviewed in WORLD CROPS and all other scientific or technical **books** may be obtained from:

Technical Books,
308 Euston Road,
London, N.W.1.
Telephone: Euston 5911.

Other miscellaneous publications reviewed should be obtained direct from the addresses given.

MACHINERY AND EQUIPMENT

For Cleaning and Dressing Grain

The No. 4 winnowing machine of Cooch & Sons Ltd. is suitable for dressing either cereals or grass seeds or grain harvested by combine-harvester; it can be used either as a cleaner before drying or for final dressing after drying.

The dressed grain is delivered into sacks at the end of the machine by means of a bagging elevator, whilst oversize rejects come from a side chute and tailing corn falls to the floor underneath. The quantity of tail corn to be extracted can be varied by means of the bottom screen, which is adjustable in the riddle frame at three different inclinations. Each machine is supplied with a standard set of six riddles (top) and two screens (bottom) for grain, unless otherwise ordered. The machine can also be supplied fitted with a small feeding elevator.

The capacity of the winnower is from 1½ to 2 tons of combine-harvested grain per hour.

The winnower can be driven either by petrol engine or electric motor. A cheaper arrangement is to have a 2A JAP engine mounted over the drum, driving by V-belt on to a flat driving pulley on the fan spindle.

With an electric drive, the motor is fitted over the drum and a push-button starter conveniently placed on the side of the machine. A 1-h.p. motor is required if both bagging and feeding elevators are to be driven, but a ¾-h.p. motor is sufficient if the latter is omitted.

The machine can be mounted on a 4-ft. stand for use in association with an 'in bin' drying plant, where the elevator that fills the bins can also be used for feeding the winnower. At this height it is possible to bag off the head corn direct from the machine into 'railway sacks' without the use of separate elevators. Spouts and bag hooks are also provided for the husk, tailings and weed seeds.

Tray Grain Drying

The 'N-H' tipping tray grain drier is a simple and foolproof unit which consists of a drying tray, elevated by a telescopic hydraulic ram, easily and quickly operated by a hand pump. Heated air from an integrally-mounted oil-fired drier unit is blown through a special seal to the plenum chamber under the tray. This is designed so that the flow of air up through the grain is completely uniform over the whole area of the tray.

Reader Service

For further information on any item of machinery or equipment reviewed in this issue please write to:

Reader Service,
WORLD CROPS,
Leonard Hill House,
Eden Street, London N.W.1,
England

The air for drying is heated by a Nu-way oil-fired furnace. Safety devices stop the flow of oil to the burner immediately should the fan stop for any reason, or if the flame is extinguished. Hence the unit can be left running unattended with complete safety. A large diameter centrifugal fan draws air over the combustion chamber and then blows the heated air through a curved duct connected to the plenum chamber by a special air seal.

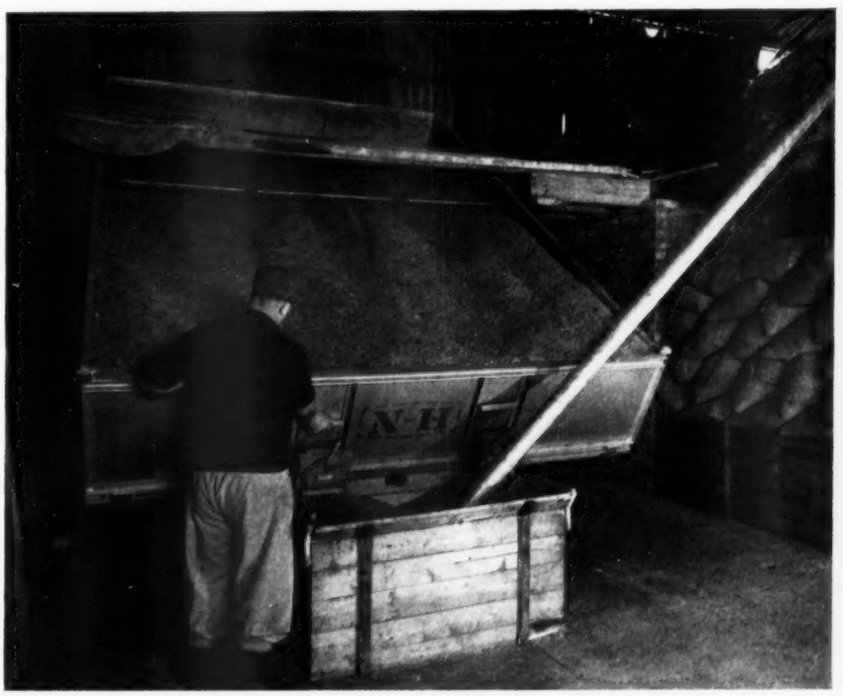
Discharge from the tray is by a hinged tailboard which is also prepared for the fitting of hookless sack holders if direct sacking is required.

Two models are made, of approximately 3-ton and 5-ton loose grain capacity (wheat) when loaded to the full depth of 2 ft. The 5-ton unit can dry 15–18 tons per day from 20% to 14% and thus can keep up with the whole output of the average self-propelled combine. The 3-ton unit can deal with 10–12 tons per day in the same range.

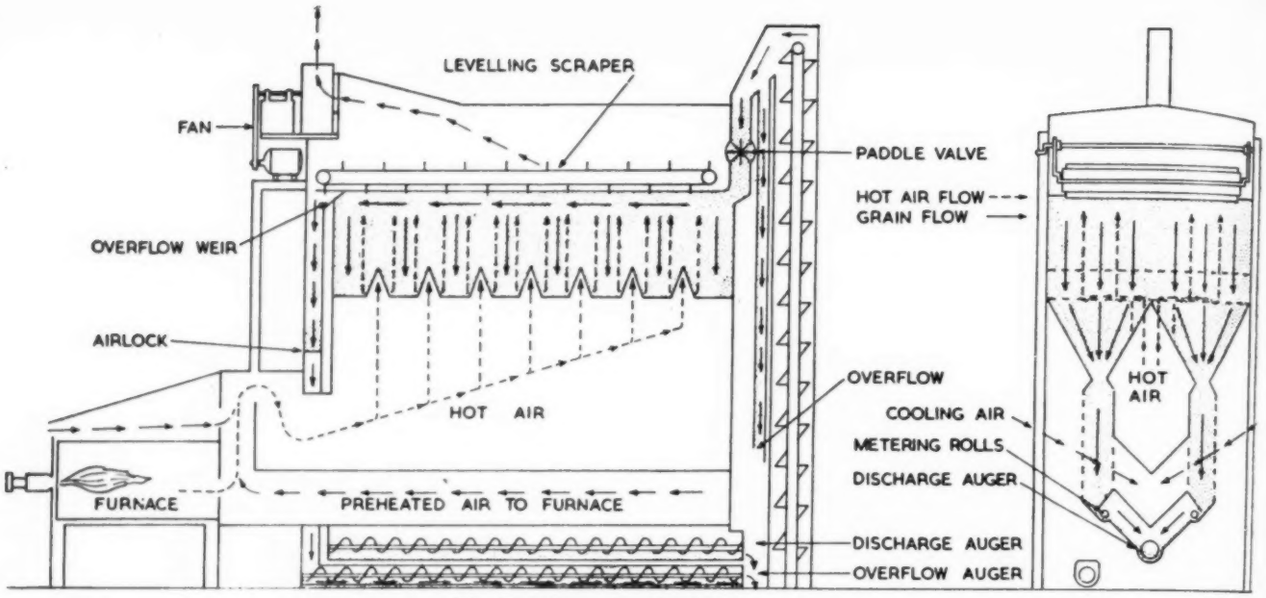
Grain Sowing with Fertiliser Placement

The 'Somerset' 16-row grain and fertiliser drill made by Denings, of Chard, and their grain-only drill are machines designed to combine large capacity with high-speed operation and a wide sowing range. This range includes all types of seed from maize and beans to grass and roots.

The machines, which have all-steel frames and are mounted on wide steel tyres, will stand up to the most difficult conditions. The wheels have a 46-in. dia. and 6-in. tread, which prevents sinkage under normal sowing conditions. The standard row spacing is 7 in., but a wide range of spacings can be obtained if required for root crops, and particularly sugar-beet, when only a few rows are required, by a simple adjustment of the coulters. The standard coulters are disk type with adjustable spring scrapers, but Suffolk and hoe coulters are available



An 'N-H' tipping tray grain drier in use on a farm



The Templewood grain drier in section

as an alternative. The sowing depth can be regulated by a pre-set lever.

Separate waterproof, large-capacity steel hoppers for grain and fertiliser enable approximately 9 bushels of grain and 4 cwt. of fertiliser to be sown at one filling. An agitator in the hopper prevents the bridging of the seed. Rates of sowing are controlled by the operation of two hand levers. The feed control gives an extensive sowing range, with a maximum of 6¼ bushels of oats per acre.

The fertiliser mechanism is based on the well-tried star feed principle, with the stars rotating alternately clockwise and anti-clockwise. Separate rubber fertiliser tubes ensure accurate placement of fertiliser on top of the thin film of soil which, by the action of the disk, has already covered the grain delivered by separate flexible non-kinking metal tubes from the grain hopper. Two gearboxes give a total of 14 speeds, the gear change being operated by a single lever. For the application of concentrated fertilisers special low-quantity stars enable amounts down to 40 lb. per acre to be sown.

Versatility in Grinding

The 'Plymouth' grinding mills manufactured by S. Corbett & Son can grind every kind of grain or any hard substance, including rice, coffee, pepper, chicory etc., and also chemical and mineral substances. A new device prevents the mill from becoming clogged and a very fine meal can be produced, if required. Grain can be ground in a much damper condition than normally, because the cutting plates run vertically.

These cutting plates are harder than steel and more durable. Constructed so as to allow a current of cold air to pass through while they are working, the grain does not become heated; and, being fitted with a pair of spiral springs, a nail or any other hard substances can pass through without injury to the plates. Access to the cutting plates is easy, so that new ones can be fitted when required. The mills are economical in use, since the speed at which they are required to run is so moderate.

Continuous Drying

The impressive 'Templewood' drier is a completely self-contained unit for the drying of grain. Its external clean lines do not reveal the efficient arrangement within; it consists of an oil-fired air-heating unit, a suction fan, a grain-drying chamber through which the grain is continually moving downwards, screw conveyors for collecting the fallen grain and provision for elevating it again to the top of the drier, so that drying goes on continually until the required degree of dryness is obtained, when the dried grain is conveyed to the bagging-off point.

Pre-cleaned grain is fed into the top of the drier and fills the drying chamber, and a levelling device, which is adjustable, ensures that it is evenly spread. While in this chamber the grain is permeated by a vertically rising flow of heated air which removes its moisture as it steadily moves downwards. This counter-flow system ensures that the grain at the top of the chamber enjoys a 'sweating' period before moving down into the region of hot, dry air. The warm emerging grain is used to pre-heat the incoming air before it reaches the furnace.

Performance figures are as follows: when drying from 21% to 15% moisture, the output is approximately 25 cwt. per hour. When used for conditioning grain, up to 4 tons per hour can be passed through the drier. Oil consumption is approx. 2–3 gal. per hour when evaporating 170 lb. of water per hour. The fan, grain-levelling device and grain metering device are all driven by electric motors and the total power consumption is of the order of 17–20 h.p.

Tread Design

The importance of the correct tyre for the job can hardly be exaggerated; obviously the standard tyre suitable for the ordinary cyclist is quite useless for the racing man. The same, of course, applies to heavy tractor tyres – the front and the rear tyre treads need to be of entirely different design.

Most of the work is done by the rear tyres and the Firestone Tyre and Rubber Co. produces a curved-bar, open-centre tyre of special design. The traction bars are curved and tapered to give maximum pulling power and the bar openings are flared to ensure

quick and positive cleaning. The tread area is wide and flat to give more inches of biting edge and the extra thick base of the tread at the inner bar ends prevents excessive movement and wiping of bars.

For tractors which are used partly for field haulage and partly for road haulage they offer the 'T.T.' rear tractor tyre. This is a further development of the open-centre tyre; while the road life is improved, there is no reduction in the drawbar pull when the tractor is in use on the land.

Tyres for the front wheels have deep circumferential grooves or ribs, which are specially designed for moving over soft ground and giving controlled steering, even under the most difficult conditions.

For Emptying Flat Bottom Bins

The 'Terrier' conveyor was designed by Penney & Porter Ltd. to facilitate the emptying of flat bottom storage bins. The basic principle is an endless belt conveyor fitted with flights and driven by a ½-h.p. geared electric motor. Running costs are low and the operation is virtually noiseless.

The conveyor is fitted with floats, which ride on the grain, and, as the contents of the bin are thrown to the outlet, the unit gradually settles down, clearing the grain, except for a small residue which can be easily removed manually.

The labour required for emptying a bin can be reduced by 75% – 80%, and the problem of men shovelling in a dusty atmosphere is avoided.

The 'Terrier' conveyor for emptying flat-bottomed storage bins

The Blanch 'Any-Level' elevator can be used in awkward places, such as this

Models are available to work at from 2 to 12 tons per hour.

Fully Adjustable Elevator

The 'Any-Level' Universal elevator, manufactured by A. B. Blanch & Co. Ltd., will cope with any normal loading problem on the farm. Having a greater bed overhang than is usual allows delivery right into the barn.

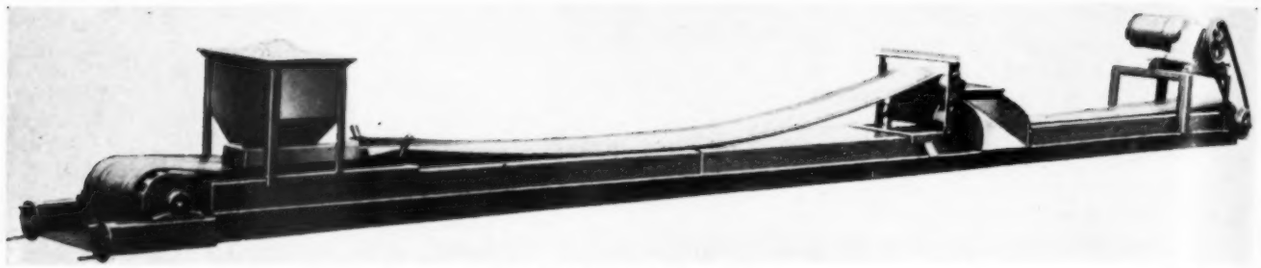
The over-reach of bed over chassis ranges from 5 ft. to 9 ft. 4 in. The patent chassis design allows movement forward, backward, sideways, diagonally and pivoting, and wheels can also be locked in one position. The elevator is fully adjustable for loading and un-loading at any height from ground level to 9 ft. and the range of delivery heights is from 6 ft. 6 in. to 18 ft. 6 in.

'Colossal!'

This is what we said of the new Massey-Ferguson '780' self-propelled combine-harvester when we saw it for the first time at Smithfield; but it is not merely a large machine, it is an efficient machine evolved in the hard school of experience. Massey-Harris-Ferguson have today more than 20,000 self-propelled machines in the field and this, their latest product, represents the results of work in more than a hundred harvesting operations.

At the controls, a flick of a lever now brings powerful hydraulic forces into action to alter speed, direction and table height – instant response to suit varying conditions and to save grain. The new method of grain-chaff separation – the 'Dyna-Air' shaker-shoe – is claimed to give more and cleaner grain; there is a controlled flow of air over both sieves, so that the chaff is kept suspended in mid-air and thus floats out of the combine, without any settlement, building or bunching.

The collecting reel is designed for equally effective operation either in standing or in 'laid' crops, and it picks up cleanly regardless of conditions. It is fitted with easily re-



Loading hopper and tension adjusters | *The ' Cary-White ' conveyor.* | *Offloader* | *Motor-drive unit*

movable spring-lock tines, which can be quickly removed and replaced by hand. With the control conveniently by the operator's right hand, it is possible to make vertical and horizontal adjustments of the table for any crop variations. There are also six working speeds to suit different conditions.

Grind Your Own Corn

The ' Essex Major ' hammer mill was specially designed for the farmer to grind his own corn. It will dry all types of grain, as well as peas and beans and pre-mixes – coarse, medium and fine – for cattle, pigs and poultry. The mill is very simple to install; all that is required is a level floor and two holding-down bolts to secure it. Any competent electrician can make the necessary connections.

The grain falls from the sack into the hopper, thence to the feed control hopper, which regulates the feed into the grinding chamber, and the resulting meal is delivered from the mill into storage bins. The new mill was shown for the first time by Christy & Norris Ltd. at Smithfield; there are two models – one 3 h.p. and the other a 5-h.p. model – and, in addition to the standard models, there is a three-in-one unit in which the hopper, the mill and the meal bin are combined in one compact and comprehensive machine.

Any-length Conveyor

The ' Cary-White ' conveyor is a machine for conveying grain, meal or other granular materials on a flat belt. It is completely free from vibration and is simple to install and maintain. It is of all-steel construction and is self-cleaning. Standard models are available with a capacity of 7, 10 and 20 tons per hour.

The basic structure of the conveyor is built up from standard sections of steel trunking, 4 ft. and 6 ft. long, bolted face to face to give a strong, rigid, but light box section. This produces a girder-like strength which makes it possible to build any length of conveyor required, even over 100 ft., needing supports at 20-ft. intervals only.

The material being conveyed is fed on to the belt by the loading hopper, where it remains in an even stream, without spreading, until discharged. In addition to discharging from the end, the conveyor can be unloaded from any point along its length, at either side, by use of the off-loader, seen in the illustration.

The direction of the conveyor can be reversed if desired by means of a simple switch incorporated into the wiring. Should it become necessary to lengthen a conveyor due to an increase in storage, the extra length required can be quickly inserted and bolted into the existing conveyor.

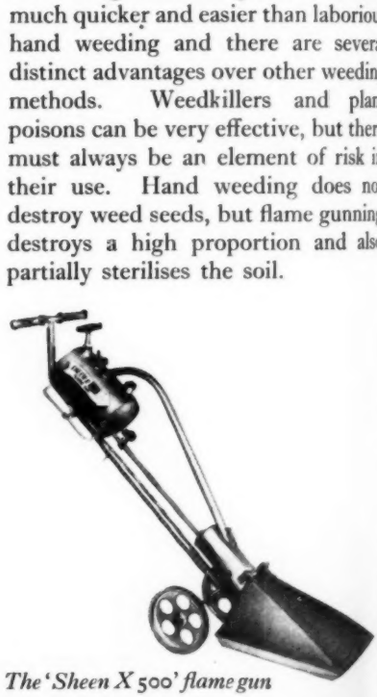
Burning Weeds

About the most frequent and distasteful job in the garden is weeding. Now, however, a lot of the drudgery can be taken out of this job by flame gunning. This method of weeding and weed control has been tried with varying degrees of success for some years, but with the equipment known as the Sheen X-100 range, manufactured by Hugh Pritchard & Co. (Nottingham) Ltd., effective weed control is possible.

Basically the equipment consists of the gun itself, which consumes paraffin on the vaporising principle; pressure is obtained by means of a built-in pump and a pressure gauge shows when working pressure has been obtained. Lighting and pressurising is simple and the guns are perfectly safe. The unit is well balanced and is quite easy even for a woman to handle.

For work between rows of growing crops and paths and drives or for fairly rough ground it is found advantageous to use the gun on the wheeled chassis, together with the new hinged hood. The purpose of this hood is to confine the flames and prevent heat from burning growing crops, and, due to the hinge, the gun is kept in direct contact with the ground no matter how undulating it may be.

Weeding with these guns is obviously much quicker and easier than laborious hand weeding and there are several distinct advantages over other weeding methods. Weedkillers and plant poisons can be very effective, but there must always be an element of risk in their use. Hand weeding does not destroy weed seeds, but flame gunning destroys a high proportion and also partially sterilises the soil.



The 'Sheen X 500' flame gun

The Sheen flame gun should not be used to consume long, rank growths completely in one operation. The correct method is to swing the gun slowly in an arc over the growth. This effectively shrivels top growths and destruction can then be completed two or three days later, when the dry tops and seeds are quickly consumed. In some cases repeat flame gunning may be necessary, but the job gets progressively easier and the weeds fewer with each application.

Two subsidiary uses for these flame guns are soil cleaning and the sterilisation of farm buildings. Soil cleaning is most beneficial for seed beds, as it ensures that the soil is free from

weeds, seeds and harmful bacteria. Other uses include such odd jobs as destroying wasp nests, cleaning ditches and destroying fungoid growths.

Two Ways of Grain Drying

The Gascoigne Mk. II grain drier, shown for the first time at the Smithfield Show, can be used either as a continuous flow or as a batch drier. Its design and dimensions (overall height 6 ft. 9 in., length 28 ft., total trough length 18 ft. and width 6 ft.) enable it to be fitted into quite a small building, without structural alteration.

The intake hopper incorporates precleaning screens, the first removing large trash, such as thistle heads and straw, and the second removing dust and small weed seeds.

An adjustable overflow weir, below the screens, returns any surplus grain to the wet pit and ensures that a constant predetermined grain depth is maintained. Propulsion of the wet grain is achieved by a shaking or reciprocating action of the trough, which creates a constant flow and eliminates the formation of ' pockets ' of wet grain.

Grain flow is completely visible throughout the drying process and can be controlled to suit grain conditions. The temperature of the hot air is easily controlled; heated by a ' Swirlamizer ' burner, which has a flame-failure cut-out, it is blown to a chamber under the grain trough and the depth of wet grain is adjusted to obtain maximum benefit. A gate is fitted at the end of the hot-air section to give the required delivery to the cooling and final cleaning section, and the grain is then ready for sacking off or conveying away in bulk at a temperature within 6° to 8° of the surrounding air temperature.

There are three outlets at the delivery end: two for head corn and the other for tail corn.

Output is from 1 to 2 tons per hour, depending on the condition of the grain, and power is provided by a 5-h.p. and a 2-h.p. motor.

A New Tractor-mounted Pump

The new Beresford ' Watermaster ' pump is a compact, inexpensive, tractor - mounted, general - purpose pump with an output sufficient for most agricultural and many industrial uses. It is a single-stage pump with a maximum output of 16,500 g.p.h. and a maximum head of 200 ft.; it is self-priming and can raise water from a depth of 25 ft.

The ' Watermaster ' has been designed for use with Ferguson tractors (types T20 and the new FE35); when required, it is attached to the hydraulic lift mechanism of the tractor in the same way as an implement and it is driven from the p.t.-o. The pump is mounted in a strong, portable, tubular frame, incorporating a robust main support bar at each end of which is an attachment pin to couple the unit to the tractor hydraulic lift side stays. Two vertical stays at the centre front of the chassis are attached to the top link of the tractor. A rack assembly or ' coxcomb ' is fitted to the tractor top link and the weight of the pump unit is supported from this rack by strong chains, attached to the stirrup. The stirrup position in the coxcomb can be varied as required. A stabiliser stay is fitted on the off-side of the tractor and secured to the pump chassis cross-bar to ensure rigidity when the pump is in operation. When not in use, or when travelling to a pumping site, the pump unit can be raised by the hydraulic lift mechanism and moved in this position. The pump is mounted in the chassis on slide-rails and its position can be adjusted by means of two bolts whenever it is necessary to alter the tension of the driving belt.

Experience has shown that a pump of simple design, with large, clear water passages and a non-clogging type of impeller, is the most practical for general agricultural and industrial use. Its range of applications is wider and it has proved more reliable than pumps which have fine clearances, many parts and seals, which may cause trouble. It will pump water containing up to 25% of solids of as much as $\frac{3}{8}$ in. in diameter, provide one or two powerful fire-fighting jets and can be used with small-bore hose as a pressure washer, all without alteration to the pump. A threaded filler cap is fitted to the top of the pump casing for initial priming. Thereafter the pump will prime automatically until the casing has to be emptied, as in frosty weather. It takes only a matter of a minute or two to attach the pump to the tractor and pumping can be started with only a short delay for priming, which may take from one to three minutes, according to the suction lift.

The pump casing is mounted on a substantial bearing pedestal in which the main pump shaft is carried. This shaft extends into the pump casing and carries the non-clog, open-blade-type impeller, this being keyed to the shaft and provided with flinger blades on the reverse side to protect the seal from grit etc. A mechanical-type seal is employed, as this automatically compensates for wear and needs no

The Beresford ' Watermaster ' pump is capable of performing many duties on the farm or estate. Here it is being used for washing down a farm tractor, while being powered by another

attention until a replacement is necessary. It incorporates a spring-loaded carbon ring which bears on a lapped bronze face and a rubber bellows to enclose the shaft. The shaft is of large diameter and is carried in a ball bearing at one end and needle roller bearing at the other, both of ample size. They are magazine grease-lubricated and for recharging a grease nipple is provided on the top of the bearing pedestal. A cast-iron crowned pulley with a 4½-in. face is keyed and secured by a nut to the shaft.

This unit will deliver water at a pressure of 83 lb./sq. in. and at 16,400 g.p.h. at a head of 50 ft., or at 22 lb. pressure on a 5-ft. suction lift. When it is used with a fire-fighting nozzle, the power of the jet is ample to extinguish quite large fires and, if a dividing breech is used, two ½-in. jets can be fitted, both having good fire-fighting power. Similarly, it has ample capacity for charging rain-lines, and it can be used to fill tanks on higher ground from streams, wells etc. for pressure-washing byres, dairies, implement yards etc. For the latter purpose smaller-bore hose is advisable and an outlet can be supplied for the attachment of a 1-in. hose. There are very many more uses for this versatile pump, including insecticide spraying, sprinkler and channel irrigation, pumping liquid manure, dewatering excavations, ponds and sumps, charging mobile tanks, root-crop washing and other duties.

Bulk Weighing

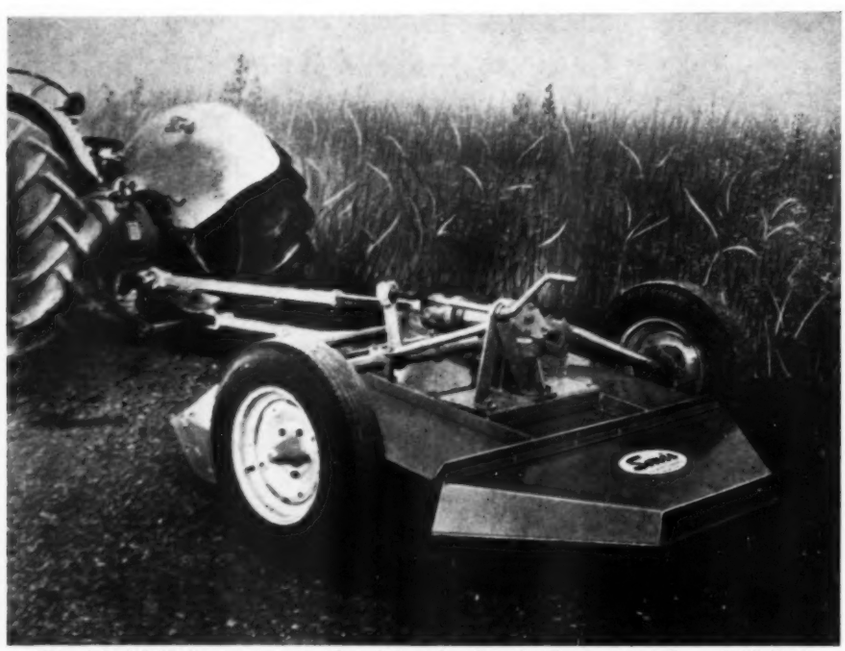
The latest addition to the products of Burrows Equipment Co., U.S.A., is their Model 1200 bulk scale, which will take 800 lb. of shelled maize and about 500 lb. of pulverised oats. This mobile weighing machine has a built-in Fairbanks-Morse scale, weighing to the nearest ounce, accurately and quickly.

The unit is 38 in. high and 30 in. wide, with a hopper 46 in. in length. All controls—2-wheel foot-brake, scale, dump handle and pushing handle —are located conveniently at the rear, within easy reach of the operator. Handling and manoeuvring of the loaded scale is easy, with standing equipment including large 10-in. rubber wheels at the front and smooth-rolling 6-in. roller-bearing swivel castors at the rear. The bin is electrically welded and is designed with sharply sloping sides to ensure complete discharge by gravity. The dump gate, 8 in. × 14 in., is controlled by a rear extension handle.

A New Mower

A new economy model 'E-60' mower has been announced by Servis Equipment Company of U.S.A. This is described as having a 60-in. cutting swath, and is especially well adapted for cutting in permanent pastures, grass verges, parks, landing fields and in vacant lots. It is also sufficiently sturdy to be suitable for cutting corn, maize, and dwarf cotton, as well as light brush up to 1½ in. in diameter.

The 'E-60' mower is equipped with two free-swinging fan-type blades steel cut gears, with Timken bearings, and an off-set blade carrier. By using an adapter kit it can be converted into either a pull-type, or lift-type mower.



The Model E-60 mower produced by the Servis Equipment Co. of U.S.A.

The Burrows bulk weighing machine

The Royal Show

Speaking at the Annual Conference of the Agricultural Engineers' Association, Mr. Anthony Hurd, M.P., spoke on 'The Place of Agricultural Shows in the Agricultural Industry'.

He said that the farmer visits agricultural shows to learn, and he felt that such shows provided an invaluable personal contact between their industry and the farmer. The Royal Show is likely to become a shop window for Europe, and many more foreign visitors are expected.

A proposal was put forward for a permanent show ground in the vicinity of London, the main reason being the necessity to provide adequate accommodation and entertainment for overseas visitors. The urgency of the problem is shown by the fact that all the available accommodation in Oxford, where the 1959 Royal Show is to be held, is already filled.

To Authors and Readers

The publishers of WORLD CROPS invite the submission of manuscripts of books to be considered for publication. All manuscripts will be promptly acknowledged and carefully considered by qualified experts. A synopsis with chapter headings should be sent in the first instance, addressed to the Book Production Manager.

Agricultural Chemicals

Rats : weeds : eelworms : and plant diseases
Plant nutrients : seed dressings : and insecticides

Rat Destruction

Where the infestation is only very small, rats and also mice can be kept under control by the use of ' RIS Warfarin 5 ' bait. This is for use by the inexperienced, as the other, more deadly, poison baits require skilled handling.

On farms, stables and poultry runs, where the large brown rat, *Mus norvegicus*, is found, ' RIS Warfarin 1 ' bait is effective, but it is ineffective against the ship rat, *Mus rattus*, the smaller black species. For these ' RIS Warfarin 5 blended ' is necessary.

The control of rats in burrows, hedgerows, refuse tips and other similar conditions is best effected by the use of ' Cymag ' dust, provided the weather conditions and state of the ground are suitable. The method of application is to place a dessertspoonful of the dust in each hole, which must then be sealed. These products may be obtained from Ratsouris Ltd.

*

Spread of Weeds

' Weedazol ', a formulation of 3-amino-1,2,4-triazole, is a product of the American Chemical Paint Co., originators of 2,4-D, 2,4,5-T and the ' Weedone ' series of herbicides. It is a systematic herbicide acting both through the leaves and the roots of plants. It is non-volatile, and non-toxic to humans, animals and fish, and readily soluble in water at normal rates.

' Weedazol ' is particularly effective in the treatment of a number of broad-leaved perennial weeds such as Canada thistle (*Cirscium arvense*), Russian knapweed (*Centaurea repens*), Leafy spurge (*Euphorbia esula*), and Horsetails (*Equisetum* spp.). Perennial grasses such as Quackgrass (*Agropyron repens*) and Bermuda grass (*Cynodon dactylon*) are controlled very well if ploughing is carried out two weeks after treatment, or if repeated applications are made.

Bullrushes (*Typha* spp.) are susceptible to one application and Nut grass (*Cyperus* spp.) can be controlled with repeated applications.

A 95–100% kill of Canada thistle in pastures may be expected with only slight temporary injury to the grasses. Although most annual farm crops are susceptible to direct application, its short soil residual is advantageous for pre-sowing treatment. Weed growth may be sprayed, ploughed after two weeks and the crop planted or sown immediately thereafter.

Cranberries, strawberries and grapes are not injured by ' Weedazol '; neither are citrus and rubber damaged even at very high rates. It is being successfully used for weed control in forestry and ornamental evergreen nursery stock.

For total vegetation control it can be mixed with TCA, dalapon, monuron, simazin and the chlorates and borates to give quicker, more effective and longer lasting results than when these other chemicals are used alone. When mixed with ' Weedazol', lower rates of these chemicals are required and costs are reduced.

In woody plant control it is effective on a number of species semi-resistant to 2,4-D and 2,4,5-T and looks especially promising on some tropical leguminous species.

*

Control of Eelworms

DD soil fumigant is a liquid containing a dichloropropane–dichloropropylene mixture. It controls root-knot eelworm, potato root eelworm and some other soil pests. Where crops are being reduced through eelworm damage, its use between crops will result in heavier yields and the cost of the treatment is much less than for steaming; where potato root eelworm is present, it is necessary to apply DD each year.

The rates of application under different conditions are as follows:

Soil	Rate per acre	Rate per 4,500 sq. ft. (e.g. a house 150ft. × 30ft.)
Heavy soils Organic soils Soils with high water table	200 lb. (16⅔ gal.)	20 lb.
Loam	300 lb. (25 gal.)	30 lb.
Light soil Where infestation is heavy	400 lb. (33⅓ gal.)	40 lb.

The fumigant is applied in the autumn soon after removing the old crop. The soil should be fairly dry and in a fine condition. It is applied by a special hand injector,* the injections being made 6 in. deep and at 15-in. intervals. It is important to make injections near walls, concrete dollies and under heating pipes as the infestation is likely to be higher in these places. To ensure that the fumes are retained, the soil should be rolled or given a light watering after treatment.

Planting should not take place for at least six weeks after treatment. The soil should be cultivated three weeks after application and further cultivations may be necessary to ensure that all the fumes have been released before planting takes place. The soil can be flooded in the usual way when all the fumes have dispersed.

*The special hand injector may be obtained from the Murphy Chemical Co.

*

High Fungicidal Properties

Much interest has been shown by fruit growers during the past two seasons in a new combined fungicide, phenyl mercury dimethylthiocarbamate, marketed under the name of ' Phelam ', by F. W. Berk and Co. Ltd.

The compound, which was first examined in the U.S.A., has been subjected to a series of trials during the past four years and has now been released for testing under commercial conditions in the principal fruit-growing areas of the British Isles as well as in several other European countries, in Australia, in the U.S.A. and in Canada.

The results obtained to date have shown that the product has high fungicidal properties through combining the eradicant action of mercury with a thiocarbamate and it gives a finish to foliage and fruit superior to that obtained by lime sulphur. In practice, it is used at half the mercury content of the normal mercurial fungicides which results in a considerable economy in spraying costs and a high degree of safety on most commercial varieties of fruit.

In addition, ' Phelam ' has been used in the tropics as a dip for the control of pineapple disease of sugarcane, and it is at present under trial for the control of coffee berry disease. Preliminary tests have indicated that ' Phelam ' will give satisfactory control of leaf rust of coffee and it has shown promise as a control for bird's-eye spot of rubber.

*

Six in One

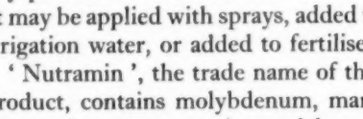
A useful combination of six trace elements in one commercially-available preparation is being marketed by Davies Nitrate Co. Inc. Designed for rapid assimilation of nutrients by plant life, the product is a dry powder which is soluble in water. It may be applied with sprays, added to irrigation water, or added to fertiliser.

' Nutramin ', the trade name of this product, contains molybdenum, manganese, iron, copper, zinc and boron. A typical analysis showing the percentage of elements is as follows: Mo, 0.46%; Mn, 9.79%; Fe, 6.02%; Cu, 3.20%; Zn, 3.06%; B, 2.10%.

*

New Type of Pesticide

' Sevin ' is a new kind of pesticide, produced by the Union Carbide International Company of the U.S.A. Chemically it is described as N methyl, l-naphthyl carbamate which is represented by the formula:



It has been found to be a safe material to handle and it ranks midway between malathion and DDT in toxicity. It is also claimed to be effective on a very wide range of insects and in field trials has shown promise on the following fruit insects: the codling moth, the red-banded leaf roller, the apple aphid, the apple maggot, the plum curculio, and other apple insects, such as the cicada. It has also given good to excellent experimental control of the European saw fly, Japanese beetles, green June beetles, Forbes scale, lygus bugs, red bugs, tentiform leaf miner, woolly apple aphid and Lecanium scale.

The new insecticide has also shown promise for the control of boll weevil, pink bollworm, bollworm, aphid and various leaf feeders on cotton; earworm on maize; Mexican beetle and leaf-hoppers on beans; and of the leaf hopper, leaf folder, berry moth and Japanese beetle on grapes.

*

Crop Spraying Timetable

A crop spraying timetable, covering the period from March to September, for cereals, grassland, peas and beans, potatoes, sugar-beet, mangolds, brassicas and other vegetable crops may be obtained from Plant Protection Ltd., on application. This instruction card also gives other useful information regarding low-volume spraying, a table of rates of application, and recommendations with regard to the use, care and maintenance of sprayers.

*

Seed Dressings

' Ceregam ' 2 is a new dual purpose cereal seed-dressing for use by merchants and farmers, produced by Bayer Agriculture Ltd. It contains gamma BHC, recognised as the most effective insecticide for wireworm control, and a mixture of organo-mercurials. Bunt or stinking smut of wheat, covered smut, net blotch, and leaf stripe of barley, loose smut, covered smut and leaf stripe of oats and striped smut of rye are all effectively controlled by ' Ceregam ' 2 which also gives some protection against foot rot and seedling blight.

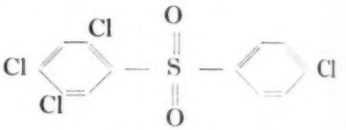
The product can be applied in any efficient seed dressing machine. Treatment may also be carried out on a hard floor, but thorough and even mixing is essential. Dosages are shown in the following table:

Cereal	*Oz./Bushel*	*Oz./Cwt.*
Wheat ..	2	4
Barley ..	2	4
Oats ..	2	$5\frac{1}{2}$
Rye ..	2	4

*

Against Red Spider

A new specific acaricide 2,4,5,4'-tetrachlorodiphenylsulphone:



has been developed in the laboratories of N.V. Philips-Roxane Industries of Holland.

Duphar Tedion V-18 contains this compound as its most active ingredient; it is available as a wettable powder, an emulsifiable concentrate or as a smoke generator for use in greenhouses against the spider mite.

This product works selectively, in that it does not kill the natural enemies of the red spider, and it is toxic neither to humans and higher animals, nor to bees, and thus it does not interfere with the transport of pollen in the flowering period.

The makers state that it does not damage the plant, not even flowering plants or sensitive crops, such as cucumbers.

It upsets the life cycle of the red spider by killing the eggs and the larvæ. It has a rather strong ovicidal action, a very strong larvicidal action and long residual activity. Thus when applied in the open, *e.g.* on apples, the after-effect lasts about three months; in glass houses, where re-infection is more frequent, about one month. It also has considerable powers of penetration, since eggs and larvæ on the undersurfaces of leaves are killed even if only the uppersides have been sprayed.

Tedion V-18 can be successfully used against spider mites on several economic crops, including: almonds, apples, beans, citrus, conifers, cotton, cucumbers, figs, groundnuts, hops, mango, melons, papaya, peaches, pears, plums, roses, strawberries, tomatoes, grapevines and watermelons, and also vegetables, flowers and ornamental plants.

Reader Service

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WORLD CROP REPORTS

Rice—a near record

INTERNATIONAL REPORT

Rice

World rice production in 1957–58 (August–July) is forecast at a near-record level. Though 1% below the record crop of the preceding year, it is well above the relatively high level of two years before. The 1957–58 total harvest is estimated at 434,500 million lb. of rough rice compared with 438,500 million in 1956–57, and with 428,000 million lb. in 1955–56.

World rice acreage in 1957–58 set a new record, but unfavourable weather reduced the yield per acre in some large areas. These new acreages are part of a continuing increase in rice cultivation during the last decade. Total world acreage is forecast at 270 million acres compared with 268 million in 1956–57, and with 263 million acres in 1955–56. The largest net increase in acreage is in Asia, though percentage-wise the greatest gain is in the countries of Africa.

Asia's production is forecast at 1% below that of 1956–57, but 2% more than two years earlier. Acreage is forecast at a slightly larger estimate than in 1956–57, and 3% above 1955–56. Rice production in *China* is reported to be above the poor crop of the year before. Unfavourable weather, however, prevented the harvesting of as high per acre yields as had been anticipated

India's 1957–58 crop dropped sharply due to October drought in four important rice States. Although another record acreage was planted, and growing conditions were excellent at the outset of the season, the prospects now indicate the smallest crop since 1954–55.

Japan increased rice acreage slightly, and a crop second only to the record of two years ago is being harvested. A very good crop was produced also in the *Republic of Korea* as a result of good weather and the increased use of fertilisers.

Pakistan's rice crop was in good condition in the first part of the growing season. Given continued favourable conditions a larger crop is expected than in the preceding year.

The acreage planted and to be planted in *Malaya* is expected to be much the same as last year. Although unusually high yields per acre last year will probably not be achieved, a very good crop is expected. Drought in *Ceylon* again adversely affected the rice crop, and the recent island-wide floods were a major catastrophe, so that the crop probably will be reduced again this year.

In the *Philippine Republic*, both acreage and yields per acre have increased again this year. A record crop is being harvested, but it is not as large as was at first anticipated.

The total production in *Burma and Thailand* – two countries accounting for over half of world rice exports in 1957 – is estimated at 32,400 million lb. of rough rice, a moderate decrease below the 34,240 million lb. estimated for the year before. Burma's harvest is expected roughly to equal the very good crop of last year, but production in Thailand is about 10% less. In *Indonesia*, production is expected to be slightly below each of the two preceding years.

Rice production in the West Asian countries is estimated at 2,000 million lb. of rough rice compared with 1,800 million lb. in the year before, and with the average of 1,900 million lb. in the five-year, 1950–54, period. Good crops are being harvested in *Iran*, *Iraq* and *Turkey*.

Rice production in *Eastern Europe* is estimated to be 16% above that of the year before. Total acreage was maintained nearly at last year's record level. Because of generally favourable weather, the out-turn was well above average in all the countries.

REGIONAL REPORTS

U.S.A.

A cut in the carryover of *wheat* seems likely before the new season opens on 1 July, largely because of record 1956–57 exports, which reduced the carryover stocks by 125 million bushels. Owing to improved varieties and management practices, a favourable growing season is expected to give a large crop in 1958, despite voluntary acreage limitations and an estimated 5 million acres that will be put into the Soil Bank's acreage reserve. About 50 million acres are expected to be harvested.

The supply of *rye* has been reduced. Exports for the remainder of this season (1957–58) are expected to be smaller than for the previous season, but the 1958 crop is likely to be about 10% less than in the past year, so a slightly larger carryover may result. The carryover of 1,010,000 tons was down by 42% last August from the year before, largely as the result of exports. If production from the 1,460,000 acres left after voluntary acreage limitations is at the 1957 level, a crop of 2,315,000 tons will be harvested in 1958. This would leave about 945,000 tons for export.

A smaller carryover of *cotton* in August is expected, both from withdrawals and a smaller crop anticipated in 1957, limited again by voluntary acreage controls. Similar control in 1956–57, however, failed to prevent a record stock of 27,600,000 bales* because of increased production per acre. The starting carryover is already down 3,300,000 bales from the record of 14,500,000 last August.

An increased carryover of feed *grains* is also anticipated as the result of last season's crops. Feed concentrate and hay supplies in 1957 exceeded those of any past year, both in total and in ratio to the numbers of livestock to be fed. The 1957 high-protein feed supplies equalled, at least, the 1956 record. The total supplies of feed grains and other concentrates were up 7% from the 1956 record 200 million tons.

The 1957 *maize* supply was larger than the previous year's record total and supplies of *barley* and *sorghum* grains were also the largest on record. *Oats* were only slightly above average. A bumper hay crop of 121 million tons, with a carryover of 18 million, left a hay supply for the 1957 season of 139 million tons.

Last year's *soya-bean* crop reached a record of 491 million bushels. *Cotton-seed* production is placed at 4,900,000 tons and, as the result of voluntary acreage limitations is nearly 11% less than in 1956: the smallest since 1950.

Larger crops are in prospect for *citrus fruits*, while the 1958 production of deciduous fruits will be somewhat higher than the near-average 1957 crop unless adverse weather interferes.

* Bale = 500 lb.

Israel

The total cultivated area rose in 1957 by 125,000 dunams* to 3,825,000 dunams. Nearly a third of this area – 1,100,000 dunams – was under irrigation, as against 980,000 in the previous year. The table illustrates the increase in production.

	1956–57 *Tons*	1955–56 *Tons*
Wheat	83,000	74,000
Maize	38,000	23,000
Green fodder ..	1,103,000	940,000
Wine grapes ..	23,400	14,200
Groundnuts ..	16,200	14,200
Cotton fibres ..	4,200	3,200
Cottonseed oil	8,200	5,250
Sugar-beet ..	59,000	30,000

The draining of the Hula Lake and its adjacent swampland provides 60,000 dunams of additional farmland of high quality; 14,000 dunams were cultivated last year and *rice* in particular was found eminently suited to local conditions, yields in the Hula area exceeding those in China and in the rice-growing regions of the U.S.A.

The most important crop is still *citrus*. In the 1956–57 season some eight million cases were exported, accounting for 40% of the nation's total exports. This was still far short of the pre-war record of 15 million cases, but new orange groves are being continually planted to make up the deficiency. The current season is expected to yield half a million cases less than the previous year because of a sudden invasion of groves by the Mediterranean fruit fly, but measures have been taken to exterminate the pest.

India

The production of *pepper* in India increased to 32,000 tons in 1955–56 from 26,000 tons in 1954–55. This production was maintained during 1956–57. The increase was appreciable in Kerala, which accounts for the bulk of the production. The target of production by the end of the Second Plan period is put at 36,000 tons, of which 8,000 to 9,000 tons is consumed in the country and the rest is exported. Next to Indonesia, India is the biggest pepper-growing country in the world.

The total exports of Indian pepper in 1956–57 were 14,840 tons, as compared with 13,127 tons in 1955–56 and 14,778 tons in 1954–55.

* Dunam = ¼ acre

Ceylon

Ceylon's exports of copra and coconut oil in the first half of 1957, at 31,261 long tons (oil basis), were one-third below shipments in the corresponding period of 1956.

Copra exports amounted to 12,730 tons, a decrease of over one-third from the first half of 1956. India, the only major market, took 99% of the total.

Coconut oil exports from Ceylon, at 23,241 tons, were about half those for the same period of 1956. Sales to Canada, Egypt and most European countries fell sharply, while shipments to Iran, Iraq and Pakistan were up slightly.

Exports of desiccated coconut amounted to only 397,960 tons, a decrease of nearly one-fifth from the first half of 1956. The U.K. continued to be the leading market, taking nearly one-half of the shipments.

Morocco

The 1957 crops, as expected, suffered badly from drought, so that wheat had to be imported for food. Early rains, which have fallen plentifully throughout the country, have improved crop prospects for 1958. The King has inaugurated a nation-wide ploughing campaign. He has exhorted all farmers to make every possible improvement in their methods, promising that money to acquire modern machinery will be provided. The cost of motor spirit and fuel oil has been reduced to agriculturists by 15 and 10 francs respectively. The campaign is one of the early features in the programme of the National Planning Council which was set up last June.

The Government has earmarked 2½ milliard francs for this season's agricultural programme of clearing and ploughing 150,000 ha. This acreage forms part of a total of 300,000 ha. to be cultivated by modern methods within the terms of the agrarian reforms promised by the King in his speech at Marrakech last June.

The 1957 harvest figures of the principal cereal crops are: soft wheat, 2 million quintals (50% of the average for the last 10 years); hard wheat, 4.3 million quintals (72%); barley, 4.9 million quintals (30%); maize, 2 million quintals (80%).

An exceptionally good yield of *citrus* fruit is expected in the winter of 1957–58 and exports are estimated to be likely to reach 230,000 tons, compared with 203,000 tons for the winter of 1956–57. The *olive* and *grape* crops are poor.

England and Wales

Although in a few districts rain delayed operations, in most areas land worked well and good progress was made with cultivations and field work, which were generally more forward than is usual for the time of year. Good progress was also made with ditching and manure carting. A large proportion of winter corn had already been sown before the month began. Conditions were favourable during December for corn drilling and, in most areas, the acreage intended for winter corn has now been sown.

Autumn-sown crops.—*Wheat* has germinated well and made good growth; some slug damage is reported. The small area of *barley* sown looks well. *Oats* are healthy and well forward. *Rye* is healthy and vigorous. *Beans* germinated well and have made steady growth.

Root crops.—Reports on the condition of *potatoes* in clamps and stores indicate that generally they are keeping well. In some districts where crops were seriously affected by blight it is expected that wastage will be above average. Good progress was made with the harvesting of *sugar-beet* although conditions were not favourable in some areas and dirt tares were higher than usual. Most of the crop has been lifted.

Pastures.—Leys continued to make growth in many districts and provided some keep, but poaching has occurred in a few areas. Permanent pastures maintained growth and have provided useful grazing in many areas. Some poaching has occurred on heavier land.

Winter keep.—Winter keep has not been extensively drawn on so far this season owing to the open weather and late grazing. There may be shortages in some upland areas but elsewhere it is expected that with normal weather conditions stocks of winter keep should be sufficient.

Acknowledgment is made to *For. Crops & Mark.* and to *Spec. Reg. Inform. Services* for much of the information contained in the above reports.

The item on England and Wales is abstracted from the monthly report of the Ministry of Agriculture, Fisheries and Food on agricultural conditions as at 1 January